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OF THE
Ministry of Agriculture

FEBRUARY, 1922.

PRINCIPAL CONTENTS.

(For Complete List of Contents see page xi.)

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(Miscellaneous Publications, No. 35.)

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(Miscellaneous Publications, No. 36.)

Wart Disease of Potatoes Order, 1919.

REGISTER OF GROWERS OF CERTIFIED IMMUNE VARIETIES OF POTATOES IN ENGLAND AND WALES, SEASON, 1921-22.

Seed potato merchants are reminded that Officers of the Ministry of Agriculture have inspected during the growing season fields of potatoes of immune varieties, and have granted certificates for such crops as were true to type and free from "rogues." The Ministry has now issued a register of the growers of these certified potatoes, so as to enable merchants to purchase stocks as required under the Wart Disease Order. Growers are reminded that only seed from crops which have been so certified may be bought for planting on land which is infected with Wart Disease.

Price 2s. 6d. net. Post free.

Order direct from the Ministry, 10, *Whitehall Place*, *London*, *S.W.*1.

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THE JOURNAL
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MINISTRY OF AGRICULTURE

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NOTES FOR THE MONTH.

Practical Application of the Results of Agricultural Research.

Several enquiries have been addressed to the Ministry by farmers and market gardeners who wished to make a practical trial of the method of converting straw into farmyard manure on the lines of the experimental work carried out at Rothamsted* by Dr. Hutchinson and Mr. Richards. Though the principle involved is established and presents no difficulties, the practical application involves much consideration of detail both with regard to attention to particular points on which success on a large scale depends and also to the conditions on a particular farm which will secure due economy of labour and material. The Ministry, therefore, advises such enquirers as may be desirous of proceeding further into the matter to put themselves into communication with the Agricultural Development Company which Lord Elveden has established on the public-spirited lines described in the letter printed below :—

15th December, 1921.

Sir,—For some years past I have been deeply interested in the furtherance of Agricultural Research and have been frequently impressed with the lack of adequate organisations to undertake the development of Research results to the stage of application to practical farming.

In the case of seeds, the National Institute of Agricultural Botany fills the need, but there is no similar organisation concerned with fertiliser and soil problems.

I have now decided to form a company called the Agricultural Development Company to fill the gap, in which company I shall provide the capital required in the first instance.

The primary object of the Company will not be to make profits for the benefits of its shareholders, but to try and develop as a

* This *Journal*, August, 1921, p. 398, and September, 1921, p. 482.

(41107) P.14/35. 11,250. 2/22. M. & S. A

business such processes as, for example, that for converting straw into artificial manure, discovered and applied by Dr. H. B. Hutchinson and Mr. E. Hannaford Richards, of Rothamsted.

It has always been my ambition to see whether it is not possible to make certain branches of Scientific Research self-supporting; and since any progress to this end requires the employment of a qualified staff and the purchase of mechanical plant, persons desirous of participating in the advantages to be derived from the process may quite fairly be expected to contribute to the cost of development by a reasonable payment either in the nature of a royalty or otherwise.

I am hoping to obtain the co-operation and assistance of those farmers who will benefit by the scientific work, as a result of which this discovery has been made possible.

The royalties now to be fixed will be available, after payment of expenses, to form a fund for further Scientific Research along practical lines in Agriculture, and in view of this I feel sure that no difficulty or objection will arise on the part of the farmers who avail themselves of this discovery to make a reasonably small payment for the right to use it, and to technical advice and assistance in its practical operation.

In view of the number of people who have followed with interest what has so far been done, I think the above information will be useful. Any communications with regard to the facilities afforded by the Company should be addressed to The Agricultural Development Company, 12, Spencer Road, Harpenden, Herts.

Yours faithfully,

The Secretary, (Sgd.) ELVEDEN.
Ministry of Agriculture and Fisheries.

* * * * * *

AT the beginning of January the Ministry of Agriculture issued the following announcement to the Press:—

Payment of Claims under the Corn Production Acts.

"The Ministry of Agriculture is now issuing to farmers throughout England and Wales cheques in payment of claims under the Corn Production Acts for wheat and oats produced in 1921, the sums paid being at the rate of £3 for each acre of wheat and £4 for each acre of oats.

"About 155,000 cheques have already been dispatched and a further 4,000 cheques will be sent out in the course of next week. The payments which are now being made are in respect

of claims made before the 18th of July last which was fixed as the final date for receiving applications. Subsequently claims were accepted up to 3rd October as an act of grace and on the understanding that payment could not be made at the beginning of the year. These latter claims number about 30,000 and these will be paid in the course of a month or six weeks, together with any outstanding cases remaining from the earlier claims, where for one reason or another the accuracy of the claim has not been proved to the satisfaction of the Ministry. In the case of about 25 per cent. of the claims received further enquiry has been necessary, and although most of these have been satisfactorily settled, a proportion still remains to be dealt with. Many of these consist of cases where an incoming and an outgoing tenant have claimed for the same crops. It is anticipated that when all claims have been paid the total sum which will have been received by growers of wheat or oats in England and Wales will amount to about £15,000,000.

"The examination and payment of these claims involves an immense amount of work which is being carried out by a temporary staff of ex-Service men under the supervision of permanent officers of the Department, and although a large part has been disposed of, much remains to be done. Persons whose claims have been duly acknowledged can rely on receiving payment in due course and are requested not to write to the Ministry making enquiries on the subject as such letters necessarily tend to delay the rapid progress of the work."

By the time this *Journal* appears a further 17,000 claims will have been paid, and by the middle of the month very few cases indeed will remain outstanding.

* * * * * *

Exportation of Horses : New Order.

AN important new Order has been issued by the Ministry entitled the "*Exportation and Transit of Horses, Asses and Mules Order of 1921*," the object of which is the better regulation of the traffic in horses by sea and rail, with a view to the protection of the animals against avoidable suffering. The Order is complementary to the Diseases of Animals Act, 1910, and the Exportation of Horses Act, 1914, which prohibit the shipment of any horses from this country to the continent of Europe unless they have been passed by a veterinary inspector of the Ministry as fit to travel and fit to work. The arrangements for the administra-

tion of these Acts were reorganised in the spring of last year, when whole-time veterinary inspectors of the Ministry were appointed to carry out the inspections at all the regular ports of shipment, and such a standard of fitness was established that the shipment of any worn-out or decrepit horse has been entirely stopped.

The new Order pursues this matter further by prescribing a certain definite standard to which the fittings of all vessels engaged in the transport of horses by sea from this country are required to conform by 1st April, 1922, and states clearly the provision which is to be made for feeding and watering the animals before embarkation and during the passage. Among other provisions the Order definitely prohibits the carriage of horses, asses or mules during the winter months except under a permanent deck cover.

Much has, however, already been done during the past 12 months to improve the fittings of vessels engaged in this trade. Although the provisions of the Order may necessitate some further expenditure on the part of shipping companies in alterations of fittings of vessels used for carrying horses by sea, they are regarded as essential for the proper protection of the animals against avoidable suffering. The marine department of the Board of Trade was closely consulted by the Ministry when framing the Order and that Department considers the Order to be a practicable one.

Horses exported to any port on the continent of Europe can now be shipped only at the ports of London, Leith, Goole, Hull, Harwich, Folkestone or Southampton. A notice in writing of every intended shipment has to be given to the Ministry's veterinary inspector at the port so as to reach him by 2 p.m. on the preceding day. Horses must be at the place of shipment at least one hour before the examination commences. During this period they are kept under close supervision to prevent doping or the adoption of any other device by unscrupulous dealers to make them appear fit when examined.

In addition, the Order re-enacts, with certain improvements, the existing provisions relating to the carriage of horses by rail, from the point of view of the prevention of avoidable suffering. Horses carried in trucks open at the sides have to be protected by tarpaulin sheets. When the journey is protracted the horses must be fed at least once in every 24 hours. The provisions as to the cleansing and disinfection of vessels and railway vehicles

used for the carriage of horses have been entirely revised. An important change in this respect is the abolition of the use of limewash, and the substitution of an efficient disinfectant.

Copies of the Order can be obtained from the offices of the Ministry, 4, Whitehall Place, London, S.W.1.

* * * * * *

Ministry's Exhibits at Agricultural Shows.

MANY farmers were interested in the Ministry's exhibits at certain of the agricultural and horticultural shows which were held in various parts of the country during the past year. In all, 24 shows were visited in 1921, including a number of the important ones, such as those of the Royal Agricultural Society at Derby, and the Bath and West Society at Bristol, as well as certain county and fat stock shows. The Ministry's exhibits have been mainly concerned with advances in agricultural research and education; with agricultural machinery; the improvement of dairying; milk recording; horticulture; fruit bottling and preservation; seed-testing and the destruction of weeds; the improvement of small livestock and bee-keeping; improvement of grassland; and, as a special section, the work connected with the repression of insects and fungi inimical to food production. In connection with the last-named, excellent models of the pests have been specially prepared under the supervision of the Ministry's Entomologist and Mycologist at the Phytopathological Laboratory, Harpenden. Specimens of ordnance survey maps have also been exhibited.

The Ministry's exhibits attracted a large number of visitors; inquiries by farmers and others were numerous; many leaflets and publications were distributed free; and priced publications to the value of about £215 were sold.

In addition to sending the main exhibit to shows, the Ministry lent smaller exhibits to a few local shows on payment of the cost of rail charges by the societies concerned. In general, it is believed that the year's work, both from the point of view of numbers visiting the exhibits and information sought and given, has proved really satisfactory and of value to those the Ministry sought to help. The expenditure which is allowed for this work is very small, but the question of renewing, improving, and adding to the exhibits in order that they may be useful to the fullest degree is being kept carefully under review.

* * * * * *

Conciliation Committees—Long Period Agreements.

AN interesting agreement for farm wages was reached in Northampton on 18th January when the employers and workers on the Conciliation Committee made terms for a period extending up to the 6th October. Although there were 23 farm wage agreements in operation at that date, there were only two long-period agreements made covering the whole season up to the end of harvest. Such agreements have the advantage on the one hand of giving farmers a settled rate of wage over a period when farm operations—including both hay and corn harvest—are in full swing, while to the labourer they offer a fixed minimum wage which will enable him to benefit by any further fall in the cost of living which may occur during the agreed period.

The principal clauses in the Northampton agreement provide that :—(1) The wages of male agricultural labourers of 21 years of age and over shall be 32s. for a week of 48 hours from 18th January, 1922, until 3rd March, 1922, and 31s. for a week of 50 hours from 4th March, 1922, until 6th October, 1922; (2) the overtime rate from 18th January, 1922, until 3rd March, 1922, shall be 8½d. per hour, and from 4th March until 6th October, 8d. per hour; (3) the ordinary time and overtime rates only shall apply during hay and harvest periods; and (4) there shall be a guaranteed week of 48 hours from 18th January, 1922, until 3rd March, 1922, and of 50 hours from 4th March, 1922, until 6th October, 1922. Provision is also made for the wages of workers under 21 years of age.

A somewhat similar agreement has been reached in Pembroke covering the period up to the 4th October at a rate of 34s. per week for 50 hours.

The example of these two counties will no doubt be carefully considered by other Conciliation Committees, and may lead to agreements being reached for longer periods with benefit both to the farmer and the worker.

The agreements relating to adult male workers, which were in force on the 20th January, were as follows :—

Area.	*Period.*	*Wages.*	*Hours per week.*
Cheshire	Up to 30th April, 1922	36/-	54
Cumberland and Westmorland ...	„ 2nd Feb., „	37/6	54 in summer 48 in winter
Durham	„ 1st March, „	44/6	50
Hampshire ...	„ 1st March, „	8d. per hour ; guaranteed week of 48 hours.	—

Area.	*Period.*	*Wages.*	*Hours per week.*
Hertfordshire ...	Up to 3rd Feb., 1922	8d. per hour; guaranteed week of 48 hours.	—
Isle of Ely ...	„ 28th Feb., „	31/- Horsemen or milkmen 40/6 for customary hours.	48
Leicester— Ashby, Bosworth, Hinckley and Atherstone.	„ 31st March, „	35/- Weekday overtime 10d. per hour. Sunday employment 1/- per hour.	50
Leicester— Melton Mowbray and District.	„ 1st March, „	34/- per week during Jan.	50
		32/- per week during Feb.	50
Middlesex, S.W. ...	„ 28th Jan., „	9½d. per hour up to 50 hours with a guaranteed week of 48 hours. Carters, stockmen, &c., 47/6.	60
Northants ...	„ 3rd March, „	32/-	48
	„ 6th Oct., „	31/-	50
South Northumberland	„ 13th May, „	44/6	50 in summer 48 in winter
Nottinghamshire ...	„ 28th Feb., „	34/-	50
Rutland	„ 31st Jan., „	34/-	48
Staffordshire ...	„ 29th Jan. „ (able-bodied workers)	9½d. per hour for a minimum week of 50 hours.	—
Surrey	„ 28th Feb., „	33/4	50
Worcestershire ...	„ 1st March, „	36/-	48
Yorkshire, North Riding ...	„ 1st March, „	37/-	50
Brecon and Radnor	„ 28th Feb., „	34/-	50
Cardiganshire ...	„ 28th Feb., „	36/-	54 in summer 50 in winter
Carnarvonshire ...	„ 13th May, „	35/-	50 in summer 48 in winter
Merioneth and Montgomery ...	„ 31st Jan., „	35/-	50
		38/-	56
Pembrokeshire ...	„ 4th Oct., „	34/-	54
Glamorgan ...	„ 31st Jan., „	36/-	50

Of the above, the agreements in Surrey and the Isle of Ely have been confirmed by the Minister on the application of the Committee.

Further details of the agreements in each county can be obtained on application to the Ministry.

* * * * * *

The Agricultural Index Number.

PRICES of agricultural produce in England and Wales, according to the index figures prepared each month by the Ministry, were slightly lower in December than in the previous month, the average of prices being about 82 per cent. above the pre-war level, as compared with 84 per cent. in November. Except for the month of August, when a rise of 16 points was recorded, due principally to a substantial advance in the price of milk, the decline was continuous throughout the year. The following table shows the percentage increase in prices of agricultural produce, in each month during the past three years, as compared with the average of the three years 1911-13 :—

Month.	1919.	1920.	1921.
	Per cent.	*Per cent.*	*Per cent.*
January	148	213	186
February	150	205	172
March	150	199	158
April	153	199	141
May	132	169	112
June	128	164	102
July	141	174	100
August	138	177	116
September	148	181	105
October	166	191	90
November	182	197	84
December	207	194	82
Year ...	158	192	121

No very great changes were recorded from November to December. Wheat and oats recovered in value to some extent, after falling continuously from June onwards, but barley was again cheaper. Live stock of all descriptions were easier in value, with the exception of fat and store sheep, which showed no appreciable alteration from the November level. Eggs reached their highest point at the end of November, and the December average of prices was substantially lower than in the previous month. Dairy produce increased in value, the average price paid to producers for milk delivered under contract to large towns showing an advance of about 1¼d. per gallon on the month; in comparison with pre-war prices, milk easily maintains its position as the dearest form of agricultural produce, and it is not surprising that of all descriptions of live stock, dairy cows show the heaviest advance in value compared with 1911-13. Of the other descriptions of produce sold by farmers, the most important are hay and potatoes, both of which showed slight declines on the month.

Feeding stuffs in most cases advanced in value from November to December, the chief increase being recorded for bran, which in December was at about double its pre-war price. Fertilisers showed little alteration, with the exception of basic slag, which was considerably cheaper; superphosphate showed a slight decline, and sulphate of ammonia an equally slight rise.

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Wart Disease of Potatoes : Approved Immune Varieties.

IN December, 1919, the Ministry issued a descriptive list of those varieties of potatoes which after careful trial had been approved as being immune from Wart Disease and which might be planted on land infected with the disease. As a result of the trials carried out in the following year, a supplementary list of seven varieties also approved as immune was issued in December, 1920. Copies of both these publications are obtainable free and post free on application to the Ministry. The list has now been further extended by the addition of the under-mentioned varieties which, following the trials conducted at Ormskirk in 1921, have been approved as immune.

First Early Variety—

Dunvegan (Sutton).

Tubers.—Oval; eyes very shallow; skin white with yellow cast; flesh lemon.

Colour of Sprout.—Purple.

Haulm and Foliage.—Dwarf, bushy foliage; leaves medium, medium green.

Flowers.—White, rarely formed.

Late or Maincrop Varieties—

Barley Bounty (Salaman).

Tubers.—Kidney; eyes shallow; skin white; flesh white.

Colour of Sprout.—Slight reddish purple.

Haulm and Foliage.—Straggling; leaves small; light green.

Flowers.—Heliotrope, rarely flowers.

Ranfurly Red (Sutton).

Tubers.—Round; eyes medium; skin red; flesh white.

Colour of Sprout.—Deep rose.

Haulm and Foliage.—Upright to spreading; leaves medium to large, drooping corrugated, medium green.

Flowers.—White, profuse.

The Celt (Findlay).

Tubers.—Round; eyes medium; skin white; flesh white.

Colour of Sprout.—White breaking red.

Haulm and Foliage.—Upright, vigorous; leaves small, medium green, corrugated.

Flowers.—Mauve, tipped white, profuse.

The immunity from wart disease of certain varieties of potatoes was first discovered in 1908, and trials were then instituted for the purpose of testing varieties of potatoes to obtain definite information as to their immunity or otherwise. These trials have been continued since that date, and year by year the Ministry has been able to declare fresh varieties as being immune. Including the four varieties mentioned above, no fewer than 100 names have appeared on the list of approved immune varieties. It is now known that some of these names relate to the same variety, and after omitting the synonyms the number of distinct varieties now recognised as immune is 63.

* * * * * *

Aber and District Welsh Mountain Pony Improvement Society.

A SUCCESSFUL experiment for improving the breed of Welsh Mountain Ponies was undertaken last season in the mountainous district of Aber, near Bangor. Normally premiums are awarded by the Ministry only in those cases where the Commons Act of 1908 is in force, as this Act provides for the formation, by the persons entitled to use the "common," of a society whose object is to regulate the turning out of entire animals on the common. As it was considered impracticable to adopt the Commons Act in this instance, the commoners formed a society for the hire of a suitable stallion and the members of the society turned the best of their mares into an enclosed "ffridd" or grazing ground some 60 acres in extent, in which the stallion "Grove Charcoal" was allowed to run with the mares for a period of three months. The hiring of the stallion cost £15, towards which a grant of £10 was made by the Ministry, and fees for service (10s.) and grazing (12s.) were charged for each mare. Sixteen members sent 35 mares for service and it is anticipated that about 60 mares will be served in 1922.

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The Ministry's Publications in 1921.

THE *Journal*.—Of the Ministry's publications probably the best known and certainly the most important is this *Journal*. Started in 1894, its growth has been gradual and steady, and, as an indication of the increased confidence which is being placed in it, it may be recorded that the last 15 months have shown an increase of 2,000 in the number of subscribers. Adverse agricultural conditions may have had something to do with this, for it is generally realised that difficult

conditions can only be countered by better methods. If this assumption is correct, the increased *Journal* sales are a tribute to the practical common sense of the farmer, for the *Journal*, as an official publication, endeavours to supply useful information of direct and practical value. The sales for December last exceeded 10,000, or about double those of pre-war days.

Miscellaneous Publications.—A range of subjects almost as wide as that of the *Journal* has been covered by the Ministry's Miscellaneous Publications during the last year. A valuable addition to the records of Plant Pests in this country was made by the "Report on the Occurrence of Insect and Fungus Pests on Plants in England and Wales for the year 1919," which, though of most interest, perhaps, to the scientist and student, has yet had a considerable sale. This series of reports is being continued, and the report for the years 1920 and 1921 will be issued shortly.

The value to trade of the practical application of mycology is, perhaps, more clearly shown in the case of the "Trials of Varieties of Potatoes Immune to Wart Disease, 1920," from which trials some commercially sound varieties of potatoes have emerged with added lustre. Much useful information on the growing of clover and grasses in this country is to be found in "A Survey of the Principal Seed-Growing Counties." The rapid progress made by the Milk Recording Scheme of the Ministry is evidenced by the steady demand for Volume 4 of the Register of Dairy Cows.

The three most popular volumes issued by the Ministry during the year have undoubtedly been:—"Rations for Livestock," by Professor T. B. Wood; "Manuring of Pastures for Meat and Milk," by Professor W. Somerville; and the "Handbook of British Breeds of Livestock."

Of these three volumes some 1,200 copies were sold in November alone, and all three have required three editions during the last 18 months.

Volumes in preparation include "Hedge and Stump Clearing Devices, Report on a Test conducted at Long Ashton, Hampshire," which will give the public authoritative results obtained at the trials of every method of extracting tree stumps in common use in this country.

Of particular value to farmers, schools and colleges—indeed, to private gardeners also—will be a new publication on "Beneficial Insects," which will include two pages of coloured illustrations, beautifully prepared, scientifically accurate and finely reproduced (in the press).

Bound Volumes of Leaflets.—The most popular volumes ever published by the Ministry have been the three Bound Volumes containing leaflets Nos. 1-300, the first volume of which has run through editions totalling 100,000 copies, while the total number of copies printed of the three volumes together has reached 225,500. For some time it had been found very difficult to keep up to date volumes containing 100 assorted leaflets, dealing with many different aspects and subjects of agriculture. From all quarters new information, sometimes of the highest importance, is constantly being brought to light, necessitating frequent revision of leaflets. Accordingly the bound volumes are being superseded by a series of small Sectional Volumes on distinct subjects, any one of which can be revised at short notice. This new system has the additional merit that it presents the leaflets in a handier form, particularly to the specialist. Five volumes of the series have already been published and others are in preparation: pending their issue the Bound Volumes are still on sale. The five volumes already isssued are:—

No. 1.—Fungus Pests of Fruit Trees.	8d.	(post free).
„ 2.—Insect Pests of Fruit Trees.	10d.	„ „
„ 3.—Cultivation and Diseases of Potatoes.	8d.	„ „
„ 4.—Fruit: Its Cultivation, Marketing and Preservation.	1s. 6d.	„ „
„ 5.—Diseases of Animals.	1s.	„ „

Leaflets.—The end of the year saw one change which, at first, may meet with the approval of few and the disapproval of many, namely, the decision to make a charge for leaflets contributory to the cost of their production. Apart, however, from the fact that the Ministry was compelled to take this step by the need for economy, many who dislike the change will agree that, as the information in the leaflets has a commercial value, those who require them should contribute to the cost of their production. Moreover, if the appreciation of information of any kind does not necessarily increase in proportion to the price paid for it, there is little or no doubt that too easy acquisition breeds not appreciation but waste, and to that extent the fact of payment does add to the value of a leaflet, and is at the same time an economy. The demand for leaflets has been very heavy, and it should be remembered that if the Ministry is able to send a copy of any one of its leaflets free to any applicant, it does not follow that this can apply to the whole 385 issued, or even to a dozen of them.

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THE SHRAWARDINE TRACTOR TRIALS, 1921.

Thompson Close, B. J. Owen, B.Sc., B.Eng., etc., and H. G. Richardson, M.A., B.Sc.
Ministry of Agriculture and Fisheries.

The Tractor Trials conducted at Shrawardine from the 19th to the 24th September last were arranged by the Society of Motor Manufacturers and Traders and were conducted on the same basis as those held by the same society in 1919.* There was therefore no attempt made, as at the trials organised last year jointly with the Royal Agricultural Society, to place the tractors in any order of merit,† but the object was to state the actual results achieved by each machine entered. The report was issued very soon after the conclusion of the trials, having regard to the amount of work involved in the compilation of the tables, and in this as in other respects the trials reflect great credit on the organisers.

The area chosen for the trial ground was admirably suited to the purpose, and although it was somewhat difficult of access, this is a drawback almost inseparable from trials or demonstrations of any size. The total area of about 500 acres was divided between 25 fields all within comparatively easy reach of Shrawardine station and the headquarter's offices. The soil varied from medium to heavy four-horse land, and only in one or two fields was it really light. The programme was so arranged as to permit all the tractors entered to be at work every day and all day, and there was very little idle time anywhere. A special effort had been made to record the performances of each machine as accurately as possible: and while improvements might be conceivable in points of detail it can fairly be said that the trials were conducted under as favourable conditions and with as efficient an organisation as it is reasonable to expect.

For recording some of the main factors in the work actually performed by the machines, Watson dynamometers were employed, designed by the Consulting Engineer of the Society. The instruments were calibrated at the National Physical Laboratory. The dynamometers are designed to record graphically the draw-bar pull, the distance travelled, the time occupied and

* See this *Journal*, October, 1919.
† *Ibid*, November, 1920.

the depth of furrow. Examples of the graphs obtained are reproduced in the report: they show clearly the time taken in turning at the headlands and the decreased pull as well as many other details of great interest. Another instrument used was the Heenan and Froude dynamometer which was employed for calculating the belt horse-power.

It had been intended to include in the trials, tests of tractor implements: but neither the time available to the technical staff employed nor the equipment on hand was really adequate for any such purpose and in the result nothing of moment was attempted. However, the opportunity given to manufacturers to exhibit tractor implements both of standard type and new design was a welcome one, which was calculated to assist farmers in the selection of implements.

Tractors and Implements Participating in the Trials.—Forty tractors were entered for the trials and 38 actually took part: of this number 11 were duplicates, and 27 different types were therefore tested. Four machines were new to British Tractor Trials:—The Renault, Avance, Simar and Service Garden Tractor. Many of the machines seen in previous trials did not enter. As contrasted with the 1920 trials the most notable absentees were the cable sets: no tractor operated by steam power was present.

Tractors have not undergone any material alteration in design since the 1920 trials, nor was there amongst the entries any considerable departure from the principles which are more or less generally accepted. There must, of course, be a number of types since there exists such a variety of conditions of soil, and one of the most interesting entries was the set of 10-18 H.P., 15-27 H.P. and 22-40 H.P. models constructed by the Case Tractor Co. The only real departures from the commonly accepted design were to be found in the Glasgow and the Avance tractors. The Glasgow tractor, with its three ground wheels all power-driven and of equal size, is well known for its hill climbing capacity and its remarkable adhesion, while the nature of the drive causes no unbalanced torque and the machine is therefore deprived of any tendency to rear or reduce its wheel pressure when pulling hard. The Avance tractor is a Swedish production and is new to British practice, the engine being of the single-cylinder two-stroke semi-Diesel (hot-bulb) type, mounted high up in the fore part of the frame and driving through friction clutch and gears to a pinion and toothed ring final drive. This machine has many interesting features; it can be used either as a four-wheel self-contained unit with two furrow plough or as a

tractor hauling a separate implement. Crude oil was used as fuel and the engine appeared to be operating satisfactorily. Garden tractors were represented by the Service and Simar machines. The Service is a miniature tractor controlled by an operator walking behind, and the Simar is operated in the same way. The latter is made in two sizes but the smaller one only was entered. The special feature of this machine is the rotary spring-mounted tines of round section steel which till the land and produce a fine tilth in one operation as though plough and harrow had been used.

The implements submitted for test included eleven ploughs, nine cultivators, two harrows, one disc harrow and three excavators. Among the ploughs were to be found a skim plough, a stubble breaker and specially designed sub-soiling ploughs.

Performance and Tests.—A pleasing and noteworthy fact was that of the 38 machines tested and demonstrated there was not one single failure. It was clearly demonstrated that machines of different types can work steadily for a week without one of them being held up for any mechanical defect other than some unimportant detail easily remedied.

The tractor drivers did not attempt to give exhibition performances, but ran their machines as if under normal conditions, and this was reflected in both the regularity of running and absence of stops due to mechanical defects. In previous trials breakdowns have been frequent, and it is apparent therefore that manufacturers have recognised and remedied defects which showed themselves in past years, while the experience gained has not been lost upon the organisers of the trial as the machines were set to do work well within the limit of their powers.

With regard to the performance of individual machines, any attempt to deal with each one, judging from mere observation of the work done, would be mere repetition, the uniformity of excellence being notable.

The power tests that were carried out were of very great interest. The engines were all submitted to a belt power test by means of a Froude dynamometer, and in addition underwent a draw-bar test by which the overall mechanical efficiency was observed. A point made clear during these tests was that in the majority of cases only a fraction of the total power developed was available for useful work, due to the lack of adhesion or gripping power in the driving wheels. Frequently the draw-bar horsepower did not represent more than one-third of the power which

the engine of the tractor was capable of producing. In nearly every case submitted to the draw-bar test, the draw-bar pull was limited by adhesion. This may have been due in part to the hard state of the ground, but even making allowance for this, the results must be considered disappointing. It is clear that the problem of adhesion needs careful and prolonged study and that this is a field of research which—like many others—should be taken up as part of a programme for investigations in agricultural machinery which may be framed either by the Ministry as part of its research scheme or by manufacturers, or by both working in conjunction. Trials cannot do more in this direction than focus attention upon a common feature or defect of machines of a wide range of types.

It has already been said that except in some points of detail the organisation of the trials was excellent, and it will not be regarded as adverse criticism if reference is made to a point which has been noticed elsewhere. In some instances advantage was not taken of the dynamometer self-registering depth gauge, and the determination of the average depth, load and speed was in effect a matter for the unaided judgment of the observer. This, however, was a failure of the human instrument.

In the case of implements the scheme of test did not appear to permit of measuring the actual disturbance of the soil (which is the essential factor) nor of pursuing the test to a comparison of the resulting yield of crop with a control plot.

The Report.—The Report has been prepared on much the same basis as the Report on the 1919 trials, although care has been taken to give additional details where these seem likely to be of service. A weakness appears to lie in the assumption made for calculating "comparative acres" ploughed per hour and other figures based on this unit. The assumption is that the resistance per square inch of furrow section varies directly as the depth of the furrow. This assumption is but tentatively made and Mr. Watson does not profess that the figures are strictly accurate: experiments recently carried out on behalf of the Ministry confirm Mr. Watson's experience that more energy is absorbed in displacing a greater depth of soil than a greater width. It would seem best, therefore, in the present state of our knowledge to avoid such an assumption as was made, unless indeed the factors to be employed in reducing all data to a common denominator are determined by *ad hoc* experiment. Unfortunately also the draw-bar horse-power results are open to question, since in the great majority of cases, as the Report

states, "both the maximum and sustained pull were less than the tractors were capable of exerting under normal conditions and on softer ground." Why this should have been it is not easy to say with certainty, although the hardness of the ground and the difficulty of penetration with spuds doubtless is a factor. The unsatisfactory nature of the results points to some modification of the test, since they are clearly valid in respect only of the exceptional conditions prevailing at the time and have no general application.

Mechanical Questions.—*Engines.*—The ordinary four-cylinder engine appears now to be almost in full possession of the field, but there seems to be an opinion that the six-cylinder engine may be introduced in the tractor on account of its greater steadiness of pull. The two-cylinder horizontal slow-speed engine still retains its position in some popular types.

The Avance tractor was unique in one respect—it was the only two-cycle hot-bulb engine for burning crude oil, and the surprising cheapness of the fuel suggests that a more extended use of this engine may be expected in the future. The Avance had a certain crudeness of design, and vibrated violently on its springs when undergoing the test for belt horse-power, an effect which was no doubt due to the inevitable unbalanced forces of a single-cylinder engine. The irregularity of turning effort, in spite of the heavy fly-wheel, seemed to be reflected in the quality of the work done. The possibilities of an engine of this type for agricultural purposes are well worthy of consideration by manufacturers, and those who favour the slow-speed power unit in preference to the high-speed type may shortly be offered a further choice.

Pulleys.—One of the principal functions of agricultural tractors is to drive stationary machinery, and for this purpose they are fitted with belt pulleys. The variety of methods in which these pulleys are fitted is very wide. It is regrettable that manufacturers seem not entirely to appreciate the fact that it should be possible to manœuvre tractors readily into any desired position; this is especially the case when the drive is crosswise to the tractor. An instance occurred at the trials where a machine took as long as 41 minutes to obtain the correct alignment and as a consequence a time limit of 30 minutes was imposed. Designers should regard the placing of the belt pulley as being one of the most important subsidiary features on a farm tractor.

Wheels and Caterpillars.—But little attention appears to have been given to the essential problem of equipping wheels with suitable devices to give the maximum adhesion under all conditions likely to be met when field work may be required to be done: one of the greatest disadvantages of the present-day wheel equipment lies in the tedious methods which are employed for fixing or removing spuds. It should not be difficult to introduce methods which would dispense with this long and tedious operation.

The draw-bar tests showed decisively how ineffective most types were in giving satisfactory adhesion under certain conditions, and it is a matter of surprise that greater attention has not been paid to what is undoubtedly one of the principal factors in tractor efficiency.

The subject of caterpillar tracks is still very controversial. *Articles on this subject have appeared in previous issues of the *Journal* pointing out that investigation is necessary before any definite opinion can be formed as to the respective merits of caterpillar tracks and wheels. This view has been more than justified as the result of the 1921 trials. If the draw-bar test is to be taken as the criterion, the performance of the chain-track machines was exceedingly good, since they developed a high draw-bar horse-power, whereas the wheel machines could not develop a power commensurate with their rating; yet at the Lincoln trials under other conditions track machines failed where wheel machines succeeded. There is great need therefore of ascertaining precisely and conclusively the relative advantages of these two systems for different conditions. Progress would be facilitated if the following relations were known:—

(1) The bearing area and pressure distributed by wheels and tracks when the load is stationary and when in motion.

(2) The theoretical form of spud or strake best suited for various broad groups of soils to obtain the best possible hold on the ground during movement, taking into consideration the most important soil factors within the range of practical ploughing.

(3) The relationship between weight of the tractor and spud penetration.

The real issue is to design a series of spuds or strakes which will meet variable conditions in such a way as to use to the fullest extent a minimum tractor weight together with the minimum of energy and disturbance of the soil, secure the maximum sensible area of contact, and still keep within the shear value of the soil.

* See the issues of this *Journal* for October, 1919, and November, 1920.

Another difficulty which obtruded itself was illustrated by the fact that the Renault machine, weighing $3\frac{1}{2}$ tons when drawing six furrows, had a tendency to lift in front. The weight on the hind part of the tracks was therefore greatly in excess of that for which the machine was designed. This effect was of course due to the reaction of the driving torque on the rear axle, and this is much greater in caterpillars than in wheeled machines.

Generally speaking, caterpillar tracks have up to the present time been a source of some disappointment, especially to those who claim on theoretical grounds that a track-laying machine should have many advantages over wheel machines. So far, where comparative tests have been made, these advantages have not been strikingly manifested.

Weight Distribution.—Another matter which calls for attention is that of weight distribution and its effect upon slippage and guidance of tractors. Slippage of tractors of different types, with the same weight distribution and under practically the same conditions, varied materially. This would indicate that there are factors other than weight entering into the question which need investigation.

Power Rating.—As showing the wide differences between the powers of the engines fitted to the various machines, it is noted that the smallest engine is given as having been of 4.3 H.P. and the largest 45 H.P. on the rating of the Society of Motor Manufacturers and Traders. The highest maximum in the trial was the Hart Parr with 30 H.P. though the Brtish Wallis was only a little way behind, while the lowest was 6.25 developed by the Service machine. The trial has indicated the wide variation existing in the rating of horse-power. A vital need is felt for a scheme standardising the power rating of tractors, as the present varying methods are unsatisfactory to manufacturers and users alike.

The trials demonstrated, as has been previously observed, that although ploughs and other implements have been modified with the object of taking advantage of the capacity of the tractor there has been no work of a fundamental character with a view, for example, to performing such work as ploughing at much greater speed than, and excellence equal to, that done by the horse plough.

The economical speed of mechanical traction is more than double that of the horse, and it appears that some of the most elementary factors influencing the question have not been rightly

appreciated. Empirically it is possible to evolve a mouldboard for a greater speed by increasing the length and pitch of the breast. The result would be the same quality of work at a greater speed. It is not, however, suggested that this would solve the problem, the magnitude of which is fully appreciated. In fact, before any really good design can be evolved it will be first necessary to carry out experiments on the relations between the design of cultivation implements and their effect on the soil. Investigation will have to be made on the lines of the effect of resistance in relation to such factors as speed, type of soil, moisture content, coupled with laboratory experiments into cohesion, plasticity and relative motion of soil particles over the mouldboard, the inversion of the furrow slice and other factors.

The problem is not one which concerns the tractor alone. It is by no means certain that the tractor represents more than a transitory method of applying power to agriculture. In many ways it is a clumsy and unsatisfactory unit, consuming in transporting its own bulk energy which should be employed in cultivation. A cheap and easily operated system of cable cultivation, whether by using internal combustion engines or electricity, crude oil or coal, may very well displace tractors: but the question of speed is as vital here as anywhere. We have been informed that with steam cable sets the economical speed for ploughing is about 3½ miles an hour, and that this is the limit because of the unsatisfactory nature of the work performed at higher speeds: but the ultimate survival of any system will depend upon the extent to which use is made of any special advantage which it offers.

Implements.—Little can be said of the actual performances of the implements, since the data collected do not take one very far, and the conditions were far from normal. The implement which attracted most attention was the Ransomes sub-soiling plough. It was to be regretted that the work done in the first field it entered was neither a satisfactory nor a typical exhibition. An attempt was made to sub-soil unnecessarily deep and a tine was employed which appeared to be too wide—although upon this point no definite opinion can be expressed without more experimental data than are at the moment at the command of the writers: the result, however, was that a heavy clay sub-soil was inverted. Better work was performed in rather lighter land, where a less arduous task was attempted: but far better work, indeed, from a mechanical point of view, perfect work has since been performed by this implement at a drainage demonstration

organised by the Ministry. Like the rest of the world, demonstrators learn by experience : and it may not be unnecessary to remind spectators, who may not have been impressed by the first exhibition of work, that the fault does not always lie with the implement.

The Ransomes Stubble Breaker and the A.B.C. Skim Plough are both designed to do work similar to the old Kent broadshare. The introduction of these implements is an indication that the tractor can be used to do work for which horses are unsuited : for there is little doubt that in many parts of the country the broadshare went out of use because, although a valuable implement for cleaning, it imposed too heavy a strain upon horses. Of the cultivators and harrows little need be said : generally they registered the advance which has been made in design and manufacture for tractor work of implements based upon horse-drawn models. The three types of Revolt excavator also mark the wide range of mechanical operations which the tractor has rendered possible. Since a fuller report on this type of implement is shortly to be expected from the Ministry, there is no need to dwell at length upon the performance at Shrawardine.

Conclusions.—The opinion expressed on previous occasions that the conditions under which trials are conducted do not give sufficient time or opportunity for adequate testing was confirmed by the 1921 trials. This is perhaps even more apparent with implements than with tractors. Sustained tests, which will extend to laboratory work on materials and soil samples, which will embrace durability and will on occasion be continued as far as the resultant crop, are not suitable as the basis for public demonstration. Of the value of trials such as these, however, primarily from the commercial and educative standpoint, the present writers are strongly convinced. It was gratifying, therefore, to see reappear a most interesting and well arranged exhibit of machinery and accessories. There can be no doubt that the combination of show-stand and demonstration is the most satisfactory, indeed the only satisfactory, way in which the manufacturer can exhibit his products to the farmer.

SOME ASPECTS OF AGRICULTURAL EDUCATION IN THE UNITED STATES OF AMERICA.

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Agriculture of all industries in the United States has been from the earliest days the largest and the most important. The rapid development of factory production and city life, dependent upon a home-grown food supply, has of late raised problems in American rural life which have compelled widespread attention. The higher wages of the city and the demand for an increase of food production during the War did not improve matters, since slowly but surely the countryside was being sapped of its best stock. The farmers' sons were moving into the cities and labour was almost impossible to obtain. In the words of the Director of Agriculture for New York State :—" Chief among our rural problems is the creation and the maintenance of an environment on the farm and in the farm home such that a fair proportion of intelligent and able American citizens will continue to earn their livelihood from the land."

New York State, with the conditions of which we shall deal in this article, has probably made as much progress in dealing with this problem as any other State in the Union. Except that its summer is hotter than ours and its winter more severe, agricultural practice is very similar to that in England. The size of the average farm ranges between seventy and three hundred acres. Maize silage takes the place of roots in dairying. The large cities, New York, Buffalo, Rochester, Albany and Syracuse demand an ever-increasing supply of fresh milk and vegetables, and of butter, fruit and potatoes. Beef, mutton, pork, horse flesh and grain can all be grown on a large scale and at less cost in the West; cotton, sugar and tobacco in the South, and all these can be shipped long distances without deterioration.

Already in 1862 the necessity for technical training and scientific study in the field of Agriculture was recognised at Washington, when the Morrill Act was passed by the Federal Government. This Act provided funds and land for the establishment of State Agricultural Colleges. In 1865 Ezra Cornell founded the University, named after him, at Ithaca in New York State, and the State College of Agriculture was added to it some years later. From the first, under the leadership of such men as Dean Roberts and Dr. Liberty Hyde Bailey, the policy of this college was to

act as help and friendly guide to the farmers in all their problems and difficulties. In 1890 the Morrill Act was modified and the necessary funds added to allow for the special preparation of instructors for teaching the elements of agriculture in schools and technical institutes.

It was not until 1909 that any decided attempt was made on the part of the different States to introduce the teaching of agriculture into the State High Schools which correspond to the National Secondary Schools in England. In that year the State of New York passed a law encouraging local communities to undertake the teaching of vocational agriculture in the High Schools. A few schools were established about the same time which were entirely devoted to the teaching of agriculture. In 1912 the Federal Government at Washington again came to the aid of the farmer and, dispensing with the existing educational machinery, passed the Smith-Lever Act. Upon the fulfilling of certain conditions by the different States, this Act voted a large sum "To aid in diffusing among the people of the United States useful and practical information on subjects relating to agriculture and home economics and to encourage the application of the same." In New York State this fund has made possible the building of a bridge between the farmers and the Research work carried on at the Agricultural College in Ithaca, at the Experiment Station in Geneva, N.Y., and at the U.S. Department of Agriculture.

The extension of work thus initiated has developed along two main lines, both outside the State educational machinery:—the provision of lectures dealing with specific problems of practice and business on the farm and in the farm home, and the establishment of a system of Junior Extension amongst the boys and girls up to the age of 14 whilst still attending the elementary schools. The first line never developed into systematic courses of instruction but was generally carried out by professors or instructors of the University on tour. All arrangements were made by the County Agents of whom there is one to each County. The second has developed, largely owing to the stimulus of the War, until there are now County Junior Extension Leaders in sixteen counties in New York State. Under the influence of these leaders and with the help of the County Agent, the boys and girls are formed into Clubs under local, and often untrained leadership, which engage in poultry keeping, gardening, fruit canning or cooking. There are now some 1,200 of these local leaders in New York State drawn from the rural school teachers,

from old graduates of the College of Agriculture and of the short courses held regularly at Cornell University, or from the teachers of vocational agriculture. In one county 1,600 boys are enrolled.

Until 1917 Agricultural Education in America was almost confined to the courses in the Land Grant Colleges, the occasional lectures to farmers and their wives on special subjects and the Club work made possible by the Smith-Lever funds. In 1917 the Smith-Hughes Act was passed by Congress at Washington.

The Smith-Hughes Act is again a gesture of impatience by the layman at the hide-bound activities and machinery of some of the State Boards of Education. It was the outcome of pressure by a group of manufacturers, a number of Labour organisations, the farmers' representatives at Washington and a Conference of Domestic Science Teachers. The Act provides:—"For the promotion of vocational education; to provide for co-operation with the States in the promotion of such education in agriculture and the trades and industries; to provide for co-operation with the States in the preparation of teachers of vocational subjects; and to appropriate money and regulate its expenditure." For the paying of salaries of teachers, supervisors and directors of agricultural subjects alone $500,000 was set aside in 1918. This sum will have increased annually until in 1926 it will amount to $3,000,000. It is allotted to States in the proportion which their rural population bears to the total rural population of the United States. In the same way by 1926 $3,000,000 will be devoted to the training of teachers, supervisors and directors in trade, home economics and industrial subjects. Every year an additional $1,000,000 is set aside for the salaries of teacher trainers.

The scheme may well be termed a lay experiment in education, for the Commissioner of Education at Washington is only one of the Federal Board which also includes the Secretaries of Agriculture, Commerce and Labour together with three citizens representing respectively the manufacturing, commercial, agricultural and labour interests of the Nation. In the States the composition varies greatly. In a few the educational authorities were excluded altogether from the State Board, which consisted entirely of laymen. It was felt that the Boards of Education would not only fail to make a move in order to fulfil the necessary conditions and to draw the Federal grant, but that they might be definitely opposed to the setting up of such unacademic courses. In New York State the scheme is run by the Board of Education in close harmony with the Board of Agriculture and in co-operation with the State College of Agriculture, where the teacher

training work goes on, and which forms the main source for the supply of graduates for the work.

For the year 1921 New York State alone will draw a total of $412,906 by fulfilling certain conditions. It has, for instance, to appoint a State Board, which may or may not include the Commissioner of Education, and to match dollar for dollar from its own or local funds. The principles lying behind this kind of grant are the following. It is held that if an individual or a community desires a thing strongly enough it will be willing to pay for it; that an individual or a community values most highly and cherishes most carefully the thing in which it has made an investment, and that Federal or State aid is for the purpose of assisting a community and not of making it a gift. The cost of establishing these Departments of Agriculture and of running and equipping them falls upon the State and the community or board which has made the initial demand. Already in 1920 there were seventy of these Departments in High Schools in New York State.

In the words of the State Director of Agriculture :—" A high school department of vocational agriculture is but a part of an organised nation-wide movement to promote better farming, better business and better living. Instruction in such a department means more than an attempt to turn back to the farm the tide that flows cityward or to induce children to stay in school, although these are natural outcomes of such instruction. The true purpose of agricultural education is to fit for agricultural pursuits those who may cast their lot with the farm. It is based on the recognition of the dignity of labour and the necessity for practical experience in the attainment of a well-rounded education. While emphasising training in the skill and knowledge necessary to control plant and animal production such education includes the usual instruction in English, history, economics, science and mathematics which every boy should receive in preparation for social efficiency and leadership in rural affairs."

These departments form therefore an integral part of the secondary school system of the State. The course is voluntary but the pupils are still directly under the administration of the Principal. Their establishment depends upon local initiative, more especially from the farmers themselves. The following particulars have to be provided :—the number of boys in the academic department of the existing High School, the number of boys residing on farms, the registration of boys in the grammar grades of the rural elementary schools tributary to the high

school, the demand for instruction in vocational agriculture, the total assessed valuation of the school district, and the extent to which farmers will co-operate in promoting the work of such a department of agriculture. The Board of Education of any city can establish such a department on its own initiative but in a union free or a common school district the question has to go before an annual or a special district meeting. With every department of agriculture is established a department of "home making" or domestic science for girls. When the resolution is once passed arrangements are immediately made for the raising of the necessary local funds. The minimum requirements made by the State for such departments of agriculture include the following:—There must be provision for at least six months of directed or supervised practical work. The course must take into special account the types of farming dominant in the neighbourhood. Two rooms and a library of books, bulletins and journals must be provided. The teacher must be enabled to attend certain conferences. There must be an enrolment of not less than twelve boys and at least fifty dollars must be set aside for the travelling expenses of the teacher in order that he may carry out what is the most important part of the work, the close supervision of the practical work, the "farm enterprise" or "home project."

Provided that the Federal demands are fulfilled the salaries of the teachers run on a sliding scale according to the amount which the Local Community is willing to contribute. In all cases the State contribution is $1.000. If the Local provision is only $200 the Federal grant is $200 also, if the Local grant is $533 the Federal grant is $866. This means that the salaries range between three and six hundred pounds per annum.

To merit such a salary as this last, sometimes in excess of that of the High School Principal himself, stringent qualifications are required. The teacher must have an authorising certificate showing graduation from a four years High School and a four years Agricultural College course. Ten per cent. of his college work must have been concerned with educational psychology, principles and methods. He must be approved by the staff of the Teacher Training Institution, which is always consulted over the matter of choice of teachers. He must be thoroughly conversant with farm life and with work on a farm. In any case his College Degree is conditional upon his having done a year's work as a farm labourer. He must have a good general knowledge of the entire field of agricultural subjects common to New York State,

including animal husbandry, dairy husbandry, poultry husbandry, soils, farm crops, vegetable gardening, fruit growing, plant diseases, entomology, farm management and farm machinery. In addition he should have specialised in some phase of technical agriculture. He should be able to connect the school work with the home work of the pupil on the farm and possess skill in the use of carpentering tools and in farm repair work. The local board of education or school committee is obliged to appoint an advisory board in the district to give advice on local farm conditions, to help to organise the " farm enterprise " work described below and to promote the success of the department by encouraging visits to their farms or by delivering practical talks.

Two courses are given, one of two and the other of four years. Many boys still leave the elementary schools at fourteen and return straight to the land. Under the new Compulsory Continuation Law of New York State, all boys and girls will stay in the High School till eighteen as soon as the necessary educational machinery has been erected.

The following is a tentative course of study for a certain district in New York State :—

First Year Agriculture:
- Farm Shop Work.
- Poultry Husbandry.
- Home Gardening.

Second Year Agriculture:
- Farm Crops.
- Soils and Fertilisers.
- Home Gardening.

Third Year Agriculture:
- Animal Husbandry.
- Fruit Growing.
- Dairying.

Fourth Year Agriculture:
- Farm Management and Economics.
- Farm Engineering and Machinery.

The accommodation at the school consists of two rooms, and if possible an experimental plot. The first room serves as laboratory and class room and contains the library, charts, papers, soil and milk testing equipment. The second room is the workshop where the boys are taught how to sharpen all farm tools and saws, to do farm repair work and elementary construction in wood, to do cold metal work of all kinds, to solder, to glaze, to mend harness and to do elementary plumbing. Simple mechanical drawing is also taught and the experimental incubator is generally housed in this room.

Of the seventy-two counts required for an academic diploma which will admit the boy to the State Agricultural College, sixteen must be gained in English, ten in science, ten in mathematics, ten in history and at least twenty-five in agriculture. For a successfully completed " Farm Enterprise," most of which

will have been carried out in out-of-school hours at home, counts are also given. In conjunction with the above course the major enterprises for the first year would probably consist of (i) the sole charge of twenty to a hundred hens, with the rearing of chickens, the keeping of a complete set of accounts, the purchase of feed and the marketing of the products, or (ii) the care of a quarter to half an acre of garden, again with full accounts. In the second year both of these would be kept on and an acre of some farm crop added, in the third a pure bred dairy calf to be reared to maturity and fed and cared for scientifically, and in the fourth perhaps a complete set of farm accounts. Such "enterprises" or "home projects" are now regarded as the most vital part of the training and are often, when properly supervised, an education in themselves. Special time is allotted in the class room for the discussion of problems which come up week by week in the project at home and also for the visiting by all the other boys of the different enterprises. In all cases the boy pockets the profits after paying his bills.

What the future development of this educational experiment will be it is impossible to say, but it was fascinating to watch the formal lecture being replaced by the round table discussion and to see the eagerness with which all the available text books bearing upon the boy's enterprise were devoured as well as the keen desire to launch out into the fields of chemistry, physics, botany, zoology, entomology and physiology in order to find a solution to the problems of daily existence.

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THE VALUE OF FOOD RECORDS IN CONNECTION WITH MILK RECORDING SOCIETIES.

G. H. GARRAD,
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EVER since the formation of the Kent Milk Recording Society the members of the Society have had the opportunity, whenever the milk recorder paid them a visit, of having the winter rations fed to the cows weighed and particulars forwarded to the agricultural organiser for criticism and advice. It is the object of

this article to show that such food records are of distinct value to the farmers belonging to the Society in enabling them to correct and to reduce the cost of feeding, and that the practice could be extended to milk recording societies in other counties with considerable advantage.

The cost of taking the food records is nil. The milk recorder visits the farm in the course of his ordinary duties and he usually has ample time, in addition to seeing the milk of each cow weighed, and marking the calves, to weigh the concentrated foods that are being used and to get at any rate a rough idea of the quantity of roots and fodder that is being fed. The prices of the various feeding stuffs are obtained from the farmer, and this information, with the number of cows in milk and the quantity of milk they have given in the day, is forwarded by the milk recorder to the agricultural organiser. The agricultural organiser calculates the cost of the ration and its composition, compares the ration with the scientific requirements of the cows, and sends the completed figures back to the farmer with his criticisms and suggestions as to how improvements might be effected.

During the winter 1920-21 every farmer was invited to put his own cost-of-production prices on his roots, hay and straw, other feeding stuffs being taken at the actual prices paid for them, and these figures were used in getting out each farmer's return for his own information; but for comparing one farmer's results with another it has been found desirable to charge the same cost per ton for roots, hay, straw, etc., in every case. The prices agreed upon were as follows:—

	£ s.
Hay	7 0 per ton.
Straw	3 10 per ton.
Mangolds and Cabbages	1 10 per ton.
Swedes	2 5 per ton.

Cakes and Meals at purchase price.

The above prices have been used for every farm and for every visit in the calculations embodied in this article.

Between November 20th, 1920, and April 15th, 1921, eighty-eight food records of herds on their full winter ration were submitted by members of the Kent Milk Recording Society, through the milk recorders, to the agricultural organiser in order that the cost and composition of the ration might be worked out and the same criticised. The food records from some farmers were only submitted once in the course of the winter; in other cases farmers submitted their food records

twice, three times, and in one case four times during this period, as the following figures show :—

Food Records taken:—	*No. of Herds.*	*No. of Cows.*
Once	27	560
Twice	18	386
Three or more times	8	120
	53	1,066

As soon as possible after each visit of the milk recorder a return is sent by the agricultural organiser to the farmer concerned, showing the cost of his ration, its composition as compared with the scientific requirements of the cows, and any criticisms or suggestions as to how the ration might be improved or reduced in cost.

A complete statement was sent out to every farmer belonging to the Society in January, and again in April, showing figures for all the herds under the following headings :—Code number of herd; date of visit; number of cows in milk; day's yield of milk per cow; cost of food per cow; cost of food per gallon of milk; quantity of roots, silage, wet grains, hay, straw, cakes and meals fed per cow; amount of digestible protein and starch equivalent in the day's ration for each cow; the scientific requirements of average-sized cows, in terms of digestible protein and starch equivalent, giving the quantity of milk quoted. From these figures every farmer is able to compare his own ration and results with those of any other member of the Society.

Taking an average of the whole of the 88 food records received, the following results are obtained :—

	Average.	*Extremes.*
No. of cows in herd	19	2 to 82
Daily yield per cow per day—lb. of milk	22·05	11·06 to 34·56
Cost of food per cow per day—pence	32·26	17·63 to 54·00
Cost of food per gallon of milk—pence	15·13	7·73 to 26·22
Daily ration in lb.—Roots	52	0 to 124
Wet grains... ...	5	0 to 40
Silage	2	0 to 45
Hay	9½	0 to 28
Straw	6½	0 to 22
Cakes and Meals ...	7½	2 to 17

As in previous years, there has been a remarkable variation on different farms in the average milk yields of the cows, the cost of food per cow per day, and the cost of food per gallon of milk.

The yield of milk per cow per day is now recognised by the best farmers as an important factor influencing the cost of food per gallon of milk, yet there are still some farms where the milk yield ranges round 1½ gallons per cow.

Herd.	*Date of Visit.*	*Yield of Milk per cow per day.*	*Cost of Food per gallon.*
		lb.	pence.
AV	Feb. 1 ...	11·61 ...	22·62
J	Dec. 8 ...	15·03 ...	19·27
BQ	Feb. 22 ...	22 78 ...	14·39
BP	Feb. 18 ...	31·47 ...	12·11
BI	March 18 ...	34·56 ...	9·80

Similarly there has been an enormous variation in the cost of food per cow per day :—

Herd.	*Date of Visit.*	*Daily ration per Cow.* *Roots.*	*Fodder.*	*Cakes & Meals.*	*Cost of Food per Cow per day.*
		lb.	lb.	lb.	pence.
AQ ...	Dec. 22 ...	nil ...	18 ...	2 ...	17·63
AL ...	March 9 ...	40 ...	16 ...	6½ ...	24·58
AD ...	Jan. 5 ...	60 ...	14 ...	7½ ...	31·40
AT ...	Jan. 4 ...	101 ...	19½ ...	5 ...	37·52
BB ...	Dec. 4 ...	62 ...	10 ...	17 ...	43·74
G ...	Dec. 9 ...	73 ...	10 ...	16½ ...	49·24
BF ...	Nov. 19 ...	124 ...	17 ...	12 ...	54·00

In all cases, it must be remembered, roots, hay and straw have been valued at the same price per ton. Every farmer has almost equal opportunities of buying concentrated feeding stuffs at the same prices; yet the cost of the ration has varied from less than 1s. 6d. per cow per day in one case to more than 4s. per cow per day in another. The quantity of milk a cow is giving should determine to a large extent the amount of food it receives, and in many herds each cow is now being fed according to the quantity of milk it gives, but several cases were found where herds as a whole were being grossly over-fed and other cases where they were being grossly under-fed.

The important figure, from the farmer's point of view, is the cost of food per gallon of milk. This figure has varied on the different farms as much as the other figures already quoted :—

Herd.	*Date.*	*Cost of Food per gall. of milk.*
		pence.
BP	April 10 ...	8·30
A	Nov. 22 ...	10·37
AN	Dec. 17 ...	15·56
BA	Dec. 18 ...	21·43
BD	Dec. 31 ...	25·21
BF	Nov. 19 ...	26·22

There was one extreme case where the cost of food per gallon of milk worked out as low as 7.73 pence per gallon, but this figure has been ignored as the cows were obviously being very seriously under-fed.

It will be noticed that the cost of food per gallon of milk was more than three times as great on one farm as on another. A criticism might be made that on April 10th herd BP was probably on a summer ration, but the ration actually being fed was 34 lb. of mangolds, 26 lb. of wet grains, 7 lb. of hay, 4 lb. of straw and 5½ lb. of mixed cakes and meals. The milk yield was high, 31.92 lb. of milk per cow as compared with 31.47 lb. of milk per cow on the same farm on February 18th. Herd BF was a herd that was being seriously over-fed. The cows were only averaging 20.60 lb. of milk and their ration consisted of 120 lb. of roots, 10 lb. of hay, 7 lb. of straw and 12 lb. of cakes and meals.

This enormous variation in the cost of feeding on different farms is not peculiar to one season; it occurs year after year. In the previous winter (1919-20), for example, eighty-six food records were submitted to the agricultural organiser, and the cost of feeding per cow per day varied from 1s. 5d. in one case to 4s. 6d. in another. Similarly, the cost of food per gallon of milk varied from 9½d. to 2s. 2½d. in different herds. In that season hay was priced in every case at £7 per ton, straw at £3 10s. per ton, mangolds and cabbages at 30s. per ton and swedes at 45s. per ton. It is evident that every year there are a large number of dairy farmers to whom a food record taken in the way already described would be of immense assistance. Heavy cost of feeding is usually due to one or more of four causes :—

(A) *A Low Milk Yield on the part of the Cows.*—A simple calculation shows that the more milk a cow gives the cheaper becomes the cost of food per gallon, because a four-gallon cow does not require twice as much fodder or roots as a two-gallon cow—a double allowance of cakes and meals will usually suffice. The most economical herds are those that yield well on a normal ration. This is a matter mainly of breeding and selection, and one of the main objects of a milk recording society is to show the members which of their cows produce the most milk, so that these cows may be used as foundation cows, put to a bull of good milking strain and the heifer calves reared.

(B) *Extravagant Feeding.*—The writer's experience is that over-feeding is a more common fault than under-feeding, though many cases of under-feeding are met with. Over-feeding occurs in several forms. Frequently it takes the form of an excessive allowance of hay, farmers forgetting that £7 per ton for hay is equivalent to ¾d. per lb. and that 28 lb. of hay at that price costs 1s. 9d. More often it takes the form of excessive feeding of concentrated foods. In one case last winter ten cows were receiving a daily allowance of 170 lb. of cakes and meals, an average of 17 lb. per cow, although they were each giving only 2 gallons of milk. This quantity of concentrated food would have been more suitable for 5-gallon cows than for 2-gallon cows. The practice of measuring out the supply of concentrated foods to each individual cow according to her milk yield is year by year becoming more prevalent and is being encouraged in every possible way.

(C) *Indiscriminate Purchase.*—The relative market prices of the concentrated feeding stuffs during the past winter were in many cases in marked contrast with their feeding values. Farmers are far too prone to be guided by their cake merchant in making their selection of what they will buy, or to buy their old favourite feeding stuffs of pre-war days regardless of present market prices, instead of comparing the market price with the feeding value of the feeding stuff with the help of such a table as is published in this *Journal* month by month.

(D) *Bad Management.*—No amount of scientific feeding will be successful unless both the farmer and his cowman take an intelligent interest in the welfare of the cows.

Most of the farmers consider that two food records taken during the course of the winter are sufficient, but the following figures show that those farmers who had three food records taken were able to produce milk still more cheaply than those who had two food records taken, whilst those who had two food records taken produced milk more cheaply than those who only had one record taken, assuming that the latter did not alter the rations that they were feeding. A comparison between the composition of the rations being fed with the scientific requirements of the cows is also enlightening :—

		Composition of Ration fed.		*Scientific Requirements of Cows.*	
Food Records taken.	*Cost of Food per gall.*	*Digestible Protein.*	*Starch Equivalent.*	*Digestible Protein.*	*Starch Equivalent.*
	pence.	lb.	lb.	lb.	lb.
Once ...	15·71	2·45	13·28	2·10	12·91
Twice ...	15·13	2·28	13·14	2·08	12·90
Three times	14·53	2·29	13·02	2·20	13·30

The scientific requirements of an average-sized Shorthorn cow have been taken as 7.50 lb. of starch equivalent, including 0.84 lb. of digestible protein for her maintenance ration, and an additional 2.50 lb. of starch equivalent including 0.58 lb. of digestible protein for every gallon of milk. It will be noticed that, on the average, the 27 farmers who had only one food record taken were over-feeding their cows, assuming the scientific requirements of the cows to be correct. The 18 farmers who had two food records taken had the opportunity of correcting their rations, with the result that their feeding on the average of the two food records taken corresponded more nearly with the scientific food requirements of the cows, whilst the rations of the eight farmers who were criticised three times are still nearer in line with the scientific standards.

The following figures show a comparison of the first food records with the second food records of 23 out of the 26 farmers who have had two or more food records taken during the course of the winter. The food records of three farmers whose herds consisted of only 2, 4 and 5 cows, respectively, and were therefore too small to provide reliable figures have been disregarded :—

	1st Food Record.	*2nd Food Record.*
Number of Cows	505	481
Daily yield per cow per day—lb. ...	20·79	22·58
Cost of food per cow per day—pence ...	33·39	31·00
Cost of food per gall. of milk—pence ...	16·06	13·73

These figures show that at the time the second food record was taken 481 cows were producing daily 1,086 gallons of milk (2.26 gal. each) at nearly 2½d. per gallon less cost than at the time the first food record was taken.

A saving of 2½d. per gallon on 1,086 gallons of milk amounts to £11 6s. 3d. per day or £2,058 17s. 6d. in the six winter months. These are the results from 23 herds only. There were 27 other herds which had their food records taken once but not twice, so that no information is available as to the extent to which they profited from the taking of the food records. The reduction in the prices of cakes and meals as the winter proceeded assisted in reducing the cost of feeding, but this effect was small because in most cases the concentrated foods were charged at the same price on each subsequent visit of the milk recorder as on the first visit. It is therefore evident that food records as well as the milk records and the information obtained from them are distinctly helpful to the dairy farmer. In the writer's opinion the taking of food

records should be an integral part of the Milk Recording Scheme. In Denmark, a country one-third the size of England and Wales but with four times as many milk-recorded cows, the milk recorders not only weigh but also analyse the milk of each individual cow at every visit—and the cows are milked three and occasionally four times a day—and still find time to take the food records. There are no surprise visits, so that the transport by the farmer of the milk-testing apparatus can be more easily arranged, but there seems no reason why in this country the usefulness of a milk-recording society should not be increased by utilising the services of the milk recorder when he arrives on a farm in taking the weights of the foods as well as of the milk at every visit.

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LIME-SULPHUR AND CALCIUM CASEINATE AS A FUNGICIDE.

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ABOUT the year 1910 lime-sulphur as a summer-wash was being confidently advocated in the United States. In this country fruit growers first turned to this new fungicide in the expectation that it might prove superior to Bordeaux mixture for the control of apple "scab," and, later, as the best wash available for fighting the recently introduced American gooseberry-mildew.

The history of the early use of lime-sulphur is largely recorded in the pages of this *Journal*. In 1910 and 1911 articles appeared (1) (2)* giving instructions for making the best lime-sulphur wash and for the standardisation of its strength, as well as the results of the first spraying experiments on apples and on gooseberries. It soon became apparent, in further experiments (3) (4) (5) that serious injury—in the form of defoliation—is caused to certain varieties of gooseberries by lime-sulphur at the standard "summer strength." Further, owing to the fact that the lime-sulphur wash when used alone does not "run" well, but dries in blotches which are remarkably adhesive and are not washed off by rain, serious disfigurement of dessert gooseberries results if the berries are sprayed during the later stages of ripening.

* These and subsequent numbers are references to the Bibliography at the end of this article.

A closely allied wash, ammonium polysulphide, discovered in 1916 (6) (7) (8), which leaves no visible deposit on the sprayed parts, can be recommended for the purpose, but this wash is in disfavour with the manufacturing horticultural chemist, owing to the difficulties met with in its preparation.

With regard to the use of lime-sulphur as a summer-wash on apples for the control of "scab," the expectation (raised by reports from the United States) that it would control this disease as well as Bordeaux mixture does, and without causing any injury to the tree, has not been fulfilled. Not only may serious defoliation result on certain varieties (*e.g.*, Stirling Castle, Newton Wonder) after spraying with lime-sulphur, but, according to the experiments (9) (10) lately carried out at the East Malling Research Station, a reduction of crop (due to the young apples falling off) may be caused.

In view of the above facts, it is obviously a matter of great practical importance to ascertain as closely as possible the exact strength of lime-sulphur which is necessary to kill the fungus, in order to see whether any of the ill-results which now follow the use of lime-sulphur under certain circumstances can be avoided by using it in a weaker solution. Although much work has been done in the orchard and plantation in spraying trees with lime-sulphur solutions of various strengths, it does not appear that carefully controlled biological observations on the sprayed fungus—such as can be made on plants grown under glass—have hitherto been recorded. The present article describes the results of experiments which have determined the strength of lime-sulphur necessary to kill the "summer," or *conidial*, stage of one of the "powdery" mildews, viz., the Hop-mildew (*Sphaerotheca Humuli* (D.C.), Burr.).

Description of Experiments.—The plants used in the spraying experiments were young hop-plants, grown in a greenhouse, infected with the hop-mildew. In previous work (11) it had been found that the mildew in different stages of development shows very different powers of resistance to the same fungicide. By the selection of only those patches of mildew in the same stage of development, *i.e.*, the so-called "powdery" patches of the conidial stage,* and on young vigorously growing leaves, it is possible to keep a sufficiently fixed standard by which to measure satisfactorily the fungicidal value of different solutions.

If a lime-sulphur solution—even in the finest possible "misty" spray, such as that given by an "atomiser"—is

* An illustration of this stage is given in the article by *E. S. Salmon*, "Hop-mould and its Control" (*Jour. Min. Agric.*, May 1921, p. 150, Fig. 2).

sprayed on to a "powdery" patch of mildew, it will be found that the fluid congregates in minute drops over the surface of the patch, so that it becomes impossible to measure accurately the fungicidal effect of the fluid, since parts of the fungus remain unwetted. It is necessary, therefore, either to treat the mildew with some substance such as a soft soap solution which will cause it to be wetted all over by the lime-sulphur wash applied subsequently, or to add some substance to the lime-sulphur which will increase its wetting properties. Both these lines of investigation were followed and gave remarkably concordant results.

In one set of experiments the patches of mildew were sprayed first with a 1 per cent. solution of soft soap (which removed the air entangled among the *conidia* and *conidiophores*, and wetted all the parts), then with water to remove the soap solution, and immediately afterwards with the lime-sulphur solution. After the treatment with soap and then with water, it was found that the mildew had not been appreciably affected, since by the fourth day after spraying the mildew-patches were fully as vigorous and as "powdery" as the unsprayed ones on the "control" leaves, and also that the lime-sulphur solution when applied to the wet mildew-patch no longer collected on it in drops, but ran through and wetted thoroughly each "powdery" patch.

Using this method, it was found that a commercial brand of lime-sulphur, of 1.30 sp. gr., containing 16.57 per cent. of polysulphide sulphur, when diluted 1 part to 99 parts of water and thus containing 0.16 per cent. of polysulphide sulphur, was fungicidal. By the fourth day after spraying all the mildew patches on the sprayed leaves (although still conspicuously white and little altered to the naked eye) were quite dead, while the "control" leaves (at the same "nodes") which had been sprayed only with the soap solution and then with water, bore vigorous, densely powdery patches of mildew.

Using the dilution of one part of the same concentrated lime-sulphur to 199 parts of water, or 0.08 per cent. of polysulphide sulphur, it was found that while the majority of the patches of mildew were killed, a few survived; in other words, lime-sulphur at this strength was apparently just beginning to break down as an efficient fungicide.

The preliminary treatment of the mildew with soap and then with water, while useful for experimental purposes, cannot of course claim to have any practical value.

In the experiments, where a substance was added to lime-sulphur in order to increase its wetting powers, calcium caseinate was found to give very satisfactory results. This substance, which has been used by A. Peterson (12) in conjunction with lime-sulphur as an insecticide, has not hitherto, we believe, been used for improving lime-sulphur as a fungicide for use in summer. It may be mentioned here that the substance known as saponin considerably increases the wetting properties of lime-sulphur (13) but the mixture was not found satisfactory for determining the fungicidal values of lime-sulphur solutions, whereas calcium caseinate gave admirably consistent results. In the first experiments 1 per cent. of calcium caseinate was used with lime-sulphur (1.30 sp. gr.) at the dilutions 1 : 99, 1 : 149 and 1 : 199, containing, respectively, 0.16, 0.11 and 0.08 per cent. of polysulphide sulphur. At the first two strengths, the solution proved fungicidal, all the patches of mildew on the sprayed leaves being dead when examined 24 hours after spraying, while the mildew-patches on the " control " leaves, sprayed with 1 per cent. of calcium caseinate alone were as vigorous as before. At the strength 1 : 199, the lime-sulphur solution was clearly not quite fungicidal—many of the patches were killed but several survived and produced new *conidiophores* and chains of *conidia*.

In another experiment the same lime-sulphur was used at the dilution 1 : 99 with 0.5 per cent. of calcium caseinate, and here again proved completely fungicidal.*

It seems probable, therefore, that the strengths at which lime-sulphur is being used in this country against mildews, viz., 1 part of the concentrated wash (1.30 sp. gr.) to 29, or 59, parts of water are to be regarded as super-fungicidal and that weaker strengths, viz., 1 to 74, or 1 to 99, will be found to be fungicidal when used with calcium caseinate in order to secure complete wetting.† Should this prove to be the case, and with regard to

* In one experiment a calcium polysulphide solution, made in the laboratory, was used at the dilution 1 : 75 (when it contained 0.33 per cent. of polysulphide sulphur) with 1 per cent. of calcium caseinate and found to be completely fungicidal.

† The calcium caseinate solution was prepared by stirring two parts of commercial casein and one part of slaked lime in twenty parts of water for about two hours and allowing any undissolved solid to settle. The supernatant liquid, used without filtration (which is extremely slow and unsatisfactory), is, roughly, a 10 per cent. solution of calcium caseinate, and half a gallon or one gallon of it is used in the preparation of ten gallons of lime-sulphur wash according as one desires to have 0.5 or 1 per cent. of calcium caseinate present. The preparation by the farmer of the calcium caseinate solution would be a tedious process; it is confidently expected, however, that this substance will be put on the market in this country by manufacturing horticultural chemists, as a similar substance, for use with arsenate of lead, is sold commercially in the United States of America.

apple "scab" also, a way may possibly be found to avoid the serious injuries produced by lime-sulphur at higher strengths on the apple and gooseberry.

Summary.—In carefully controlled experiments it has been found that lime-sulphur at a strength of 1.003 sp. gr. (1 gal. of the concentrated wash (1.30 sp. gr.) to 99 parts of water) and containing 0.16 per cent. of polysulphide sulphur, is lethal for the "powdery" conidial stage of the hop-mildew,* when the lime-sulphur is used with calcium caseinate in order to secure complete wetting of the fungus.

It is considered probable that lime-sulphur at this strength and mixed with calcium caseinate will be found lethal for the American gooseberry-mildew also (and other "powdery mildews") and that at this dilution lime-sulphur may be used on ripening dessert gooseberries without fear of disfiguring the fruit for market.

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* It must be pointed out that under practical conditions "flowers of sulphur," and not lime-sulphur, is to be recommended for use against hop-mildew. (See *Salmon, E. S.*, "Hop-mould and its Control," (*Jour. Min. Agric.*, May, 1921, p. 150).)

TRANSPORT OF STRAWBERRIES FROM THE CHEDDAR VALLEY.*

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A branch line of the Great Western Railway from Yatton to Wells serves the Cheddar Valley district, and the three principal stations, at which fruit is loaded are Cheddar, Axbridge, and Draycott. The bulk of the fruit is dispatched to market by rail, but a small quantity is conveyed to Bristol by road, and an appreciable quantity meets a ready retail sale to the numerous motor-coach parties and visitors to Cheddar Cliffs and Caves. It is estimated locally that during last season between forty and fifty tons have reached Bristol by road, and about thirty tons were sold to visitors at Cheddar.

Railway Arrangements.—The Great Western Railway Company provide special facilities for strawberry traffic, during the season, at Cheddar, Axbridge, and Draycott Stations, and a special fruit train is run when at least six vans can be filled with fruit. The Cheddar Valley Fruit Growers' Association practically controls the available railway transport, and has a strong Committee of growers, which meets nightly during the season. The usual business is to decide (1) whether, in the opinion of the growers, the supply of fruit will warrant a special train the following day, in which case the Secretary of the Association notifies the station master at Cheddar, and (2) after discussion of ruling prices, the destination of the following day's crop. Non-members of the Association, who wish to take advantage of the through vans, are thus forced to consign to the same markets as the Association. Smaller consignments for other markets are dispatched by ordinary passenger trains.

In all nine special trains were run last year. The heaviest dispatch was on June 6th, when twenty-one tons of fruit left the Cheddar Valley. Special facilities are accorded by the railway company for quick transit, to ensure prompt arrival at the early morning markets.

Types of Vans in Use.—There have been four types of van in use on the Cheddar Valley Line :—

(*a*) A large ventilated van on eight wheels called a "Siphon C" (Fig. 1). This has two rows of shelves suspended by chains on each side

* See "Strawberry Growing in the Cheddar Valley of Somerset." *A. D. R. Walbank*, this *Journal*, Jan., 1921, p. 911.

FIG. 1.—Interior of large ventilated "Siphon C" Railway Van.

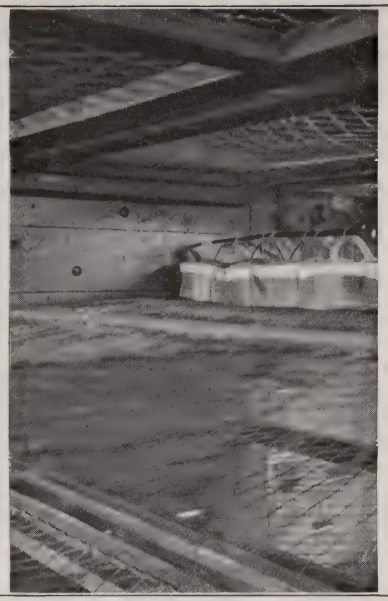

FIG. 2.—Interior of Railway Fruit Van "D."

FIG. 3.—Method of handling Strawberry Chips.

of the van, and is fitted with a concrete floor. It is about 60 ft. in length, and when packed with chips one layer deep on floor and shelves, will hold about three tons. Probably this is the easiest van to pack, but its capacity is limited, compared with its length.

(*b*) A van known as Fruit Van "D," convertible for other purposes (Fig. 2). This is a van entirely filled with four layers of wire shelves in sections, and when the shelves and floor are filled with chips one layer deep, it will hold from 44 to 48 cwt. Probably this is the most economical van but it is rather more difficult to pack. Its great advantage is that it does not permit the chips to be "topped." The van is ventilated.

(*c*) An ordinary milk siphon van with lattice sides and fitted with wooden shelves. Capacity in single layer about 30 cwt.

(*d*) A small enclosed ventilated fruit van with wooden shelves. Capacity about 1 ton.

Method of Packing.—Nearly all fruit from the Cheddar Valley is marketed in 4 lb. chips. Punnet cases to hold thirty-two 1 lb. punnets are occasionally seen, but these are used only for fancy fruit. Although in some districts the total weight of the chip and fruit is 4 lb., it is customary in the Cheddar Valley to consign 4 lb. net weight of fruit. The Growers' Association feel that they are meeting unfair competition from other districts, where the light-weight chip is used, and are considering giving a guarantee next season that each chip contains 4 lb. net weight of fruit when dispatched.

In this district, there is a very interesting practice, which might be very profitably extended, of lashing a strong stick or spar to the handles of four or more chips (Fig. 3). This gives much greater stability to the package, and packing in the vans is enormously facilitated, as a man can easily handle two sticks, totalling eight baskets, at once. When packed in this way, should it be necessary to top the fruit in the vans, it is much better protected, as other packages can be laid across the sticks, without actually coming in contact with the chips below.

The fruit is always covered in the chip, the covers used being of three types:—(*a*) Muslin (cost 7s. per gross); (*b*) Transparent grease-proof paper; (*c*) Thick non-transparent paper.

The muslin tops give by far the neatest appearance, and also give the buyer a chance of inspecting the fruit without removing the covers. The transparent grease-proof paper is the next in order of merit.

The effect of the method of packing is seen in the prices realised. One grower who invariably uses muslin, claims that he commands 2½d. to 3d. per lb. above the ordinary pack. A neatly packed transparent grease-proof paper will realise 1d. per lb. more than non-transparent paper.

The chips are manufactured locally and sold at 26s. per gross.

Handling and Delivery of Fruit.—The growers are most particular to ensure that the fruit arrives at the station in good condition. Fruit is very rarely topped on the growers' carts, but shelves are fitted to allow the fruit chips to travel in single layers

Markets and Market Charges.—Apart from Bristol the three principal markets favoured by the Cheddar Valley growers last year were Birmingham, Manchester and Liverpool.

Before the commencement of the season, many commission salesmen and their agents tour the district, and solicit fruit for sale on commission.

The Association Marketing Committee discusses any case of sharp practice on the part of commission salesmen, and any man not playing the game soon finds his supply cut off.

In addition to the carriage, most salesmen compel the grower to meet a charge of 1d. per chip for porterage. In addition the salesman usually takes 7½ per cent. commission on the sale price. In Birmingham market, it is customary to credit the grower 1d. per chip for the value of the chip, and this credit is occasionally allowed by salesmen in other markets.

Claims against the Railway Company.—It is interesting to note, that in spite of the tonnage carried up to June 25th last (223 tons 17 cwt.), claims have been received from growers for total loss of fruit to the extent of only a few cwt.

* * * * * *

A CHIP BASKET FACTORY.

J. W. Lawry, Calstock.

It is generally agreed to be highly desirable that the country-side should be more fully developed, so as to provide remunerative employment for far greater numbers than at present. Nearly all the great factories are located in large towns and cities, and in many cases there are reasons why this is unavoidable, but in others the reasons are emphatically in favour of the industries being transferred to the rural districts. In the following paper an instance is given of such a transfer and the successive steps that led up to it.

For over fifty years the Tamar Valley has been known throughout the Kingdom as a great fruit growing district, especially for strawberries, of which it annually sends the earliest English supplies (grown in the open) to the various British markets. The writer sent the first consignment from Cornwall some 60 years since. Through improper packing this first venture was

a failure, but subsequently 1 lb. punnets were obtained from London. The fruit was ready for gathering some ten days earlier than from other out-of-door sources, and very high prices were obtained. From this small beginning the strawberry industry has continuously extended until the present output of the district is several hundred tons per annum. As this quantity is almost all put on the market in small packages an enormous number of packages is required.

At first, as above stated, punnets were obtained from London, but as the acreage of strawberries grew it was felt that an effort should be made to make them locally. Arrangements were first made with a Plymouth firm of timber merchants who installed special machinery for cutting the timber into shavings of suitable length and width. The shavings were tied into bundles and forwarded to the fruit growing district, where the women and children soon learned to weave them. The price paid for this work was 1s. per gross. The work was done in the workpeople's own cottages, and occupied them through the autumn and winter months. Later a further progressive step was taken, when steam planing machinery was installed in the district where the fruit was grown, and the business developed so successfully that besides supplying the local need, some thousands of gross were annually supplied to growers in Hampshire and Middlesex and even so far afield as Edinburgh. This continued until some ten years ago when another kind of package became popular and rapidly superseded the round punnet. This was the chip basket, a strong neat package containing 3-4 lb. (or for fruit other than strawberries 12 lb.) each. These baskets, which had metal handles and a cardboard, or chip, cover, did not require to be packed in cases as the punnets did, and were much preferred by the public. They were supplied in thousands from factories at Manchester and Glasgow, and consequently the punnet-making of the Tamar district ceased.

About the time when this happened the growers of the district formed themselves into a Fruit Growers' Co-operative Association, chiefly for the purpose of obtaining better prices for their fruit, especially that which had to be sold by the ton for jam.

They were materially aided in this by the officials of the Agricultural Organisation Society, who attended several meetings and explained the advantages of such co-operation. Some of the members of this Association were willing to increase the capital of the Association so as to establish a chip basket factory, but, as the outlay for providing the necessary plant would have been

heavy, a large number objected. There the matter stood, when in 1917 a large building within a hundred yards of the railway station, and adjoining the quays on the riverside, which hitherto had been occupied as a brick-making factory, was on the market for sale. Some of those who had previously desired a factory to provide their own baskets, saw that this offered a rare opportunity to carry out their wishes and took immediate steps to form a Limited Liability Association. The nominal capital of the Company is £4,000, with shares of £1 each, and 3,000 shares were subscribed chiefly by members of the Tamar Valley Fruit Growers' Association. The building referred to was acquired on favourable terms and contains an area of 5,000 sq. ft. under cover, and large yards available for the storage of timber in the open. Information was obtained through a similar chip factory, as to where the necessary plant could be obtained, and the engine and plant were installed by August, 1919.

Next came the work involved in procuring the right kind of timber (poplar, or similar soft wood), in planing it into suitable chips or shavings, and finally teaching girls to weave the baskets, wire stitch them, and prepare and fix handles and covers. All of this was satisfactorily performed after a few months' practice, until at present the quality of the baskets is such that applications for supplies are coming from distant places, such as Herefordshire and the Channel Islands, as the baskets are believed to be superior to those obtainable elsewhere.

The factory at present employs 8 men and 18 women and girls. During the first year's working over 400,000 packages were made and sold, and in 1921 over 500,000, the quantity of timber used annually being over 300 tons.

It is found that chip baskets are not only the best type of package for strawberries, but, also for other small fruits, such as raspberries, gooseberries, peaches, cherries and plums, except when for jam purposes. Dessert apples also realise a higher price when carefully packed in 12-lb. chips. The demand is increasing so fast that steps are in contemplation for increasing the accommodation so as to do a much larger business.

This short note would not be complete without reference to Mr. Richard H. Petherick, the energetic and capable Secretary of the Association, to whose foresight and enthusiasm the Association mainly owes its inception and success and also to its capable manager, Mr. J. Billing.

In conclusion it may be pointed out that there are many other fruit growing centres which are being supplied with baskets

made in distant cities which might follow the example described above, both to their own advantage and that of the rural workers.

The advantages to the growers are that they get their supplies at a lower price and without any cost of, or delays in, carriage, while they are also supplied with a better article.

The workers have the great advantage of living under the most healthy conditions, surrounded by green fields, and free from the smoke and grime of city life. The contrast between these workers on leaving the factory for their homes at the close of their day's work, and those returning from work in the cities is very noticeable—greatly to the advantage of the former, whose glow of health, vivacity and sprightliness are markedly different from the pale face, weary look and jaded gait of many city workers.

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APPLE GROWING IN AUSTRALASIA AND AMERICA:

A Comparison with English Conditions.

C. R. Wimshurst, B.Sc.Agric. (Lond.).

The following considerations represent the result of personal inquiry into conditions of apple production in Western Australia, Victoria, Tasmania, New Zealand (North Island), British Columbia, Washington and Oregon, Ontario and New York State at the end of the late War. The inquiry was undertaken (1) owing to a sense of grievance at the comparatively poor prices obtained by really good home produce as compared with those realised by imported fruit, (2) out of curiosity as to how it was possible to produce cheaply such excellent fruit as that coming from Australasia, Canada and the U.S.A. with labour paid at the high rates obtaining in those countries, and (3) to ascertain what were the factors operating to prevent production of competitive material by the English grower.

The sense of grievance at poor prices obtained in competition soon gave place to one of admiration at the achievements of the Colonial apple grower in the face of formidable obstacles: the hacking out of a smiling orchard from the giant and gloomy gum forests of southern Tasmania surely requires the heart of a lion coupled with the patience of a Job, and one ceases to wonder at the achievement of such men in finding a market for their perishable produce half-way round the earth. The secret of their success has, of course, been loyal co-operation in marketing, but—and this is an important point—loyal co-operation

only obtained as a result of common adversity and appreciation of the unpleasant consequences of failure to co-operate. The failure of co-operative institutions among English fruit growers may be ascribed not so much to any inherent inability on their part to be loyal to each other in adversity, as to the fact that times have never been so bad that a grower could not find a market of some sort on his own initiative. The colonial grower produces fruit under conditions which mean the inevitable yearly glut of the local markets: the co-operative marketing association or the State Legislature, which controls the export organisation, can thus impose stringent regulations as to quality of produce exported and can command implicit obedience from the growers under threat of refusal of their produce, for which there is no local outlet. An Inspector of a Pacific Coast State who finds Codlin Moth infection in a single box of Extra Fancy grade dessert apples proceeding by rail for export, will condemn the whole carload—often 800 boxes. One can easily see therefore that growers of export fruit there, will take more than a leisurely interest in eradicating Codlin Moth from their plantations.

Cheap production by labour paid at high rates has been made possible in fruit-growing by the adoption of those principles of factory production that have brought such success to other industries—namely, high production of a limited variety by a minimum of labour.

Australia has concentrated on the small open-centred "Bush" type of tree grown on Northern Spy stock, which confers freedom from Woolly Aphis (*Schizoneura lanigera*) on the root system. In Western Australia it is reckoned that a man and his wife, with the help of two casual labourers at harvest time at 12s. 6d. per day each (1920), can do all the work of cultivating, pruning, thinning and spraying 12 acres of orchard planted with these small trees at 20 feet square and growing to a maximum height of 11 feet. This area represents an average of 3,600 boxes of exportable fruit per annum on the best managed plantations. All fruit can be gathered from the ground or a very small step-ladder, and intercropping is out of the question owing to the necessity for continual summer cultivation to tide over the rainless period. The export varieties of Western Australia are four only—Cleopatra, Jonathan, Five Crown, and Munro, with Yates as a probability in future: all these are keeping dessert varieties. Western Australia, while starting late, has been able to profit by the mistakes made by other States, so that her apple industry may now be looked upon as the most up-to-date on the continent.

On the Pacific Coast, where labour rates are higher—4 to 6 dollars per day being paid at harvest time in 1920—specialisation and production have to go still further, and 300 boxes per acre is not considered sufficient. Growers have there developed a bigger type of tree kept as near the ground as possible. An orchard of irrigated trees planted 30 feet square on vigorous seedling stocks, with about 2 feet of trunk and growing to a maximum height of 14-15 feet, will not uncommonly be made to produce 800 boxes of export fruit per acre at 15 years old. Once the tree is well shaped with a " modified leader " filling up the centre of the tree very little pruning other than a yearly thinning out is found necessary, a contrast to the continual and thorough spur-pruning necessary on the small Australian trees.

Ability to gather the fruit from a step-ladder is an essential factor in orchards producing export fruit: the lean-to ladder is as obsolete in such orchards as the hand-hoe. It is perhaps in their methods of handling the fruit at harvest time that the Pacific Coast States particularly excel. The grower merely picks his crop into boxes and takes these down unclosed on a motor truck to his fruit company or co-operative association; he unloads each box down a sliding chute which conveys it to a large storage basement; here each grower's crop is stacked separately until conveyed by machinery to the top of the building for machine grading and packing. To bridge a distance of even 50 feet between the end of a receiving chute and two men stacking in a corner of the basement, it has been found worth while to use small portable conveyors on roller bearings at a dollar per foot! Where labour at 6 dollars per day is to be saved, capital expended on mechanical aids to labour is never grudged. After it has been graded and packed the fruit is " shipped " in car loads of any one grade and variety in refrigerator freight-cars holding up to 800 bushel boxes each. Packed according to the State grading specifications and subject to examination at any time by the State inspectors, a bushel box of Extra Fancy Newtowns means something very definite to a buyer in any country and thereby earns a premium which an individual English grower can hardly hope to command even if he can grow identical material.

Can he, however, grow identical material? The writer is rather sceptical on this point. Okanagan Valley, Wenatchee, in Washington State, U.S.A., and the Huon Valley of Tasmania have the climate *par excellence* for box apple production. It would appear to be a fact that all boxed apples exported to

England come from localities that can mature a "cob" of maize in the open during the summer. The climate of S.E. and E. England, the driest that we can manage, is not warm enough to do this, and is far moister than is good for box apple country. S.E. England approximates in climate to the coastal belt of British Columbia, Washington and Oregon, which is what they would call over there "berry country," more suitable for raspberries, blackberries, gooseberries, etc., than for hard fruit. Even this coastal belt, however, will mature a "cob" of maize in the open during the summer: it will grow apples and pears readily enough, but its moist atmosphere makes the operations necessary to eradicate black spot (*Venturia inaequalis*) and other fungoid diseases too costly and uncertain, in comparison with those sufficing in "God's own country" over the coastal range, with its bright dry atmosphere. Spain and Portugal, Northern Italy, and Southern Russia have more the climate for box-apple production than S.E. England. Wenatchee (Washington, U.S.A.) was growing sage-bush and other desert vegetation before an irrigated system made apple growing possible. Indeed, certain strains of the apple would appear to have originated on the fringe of the deserts of Central Asia so that to find it flourishing under arid conditions is perhaps not so surprising as might at first appear. Near Perth in Western Australia or Auckland in New Zealand, flourishing apple orchards producing quality in quantity are found next door to plantations of lemons and other citrus fruits.

In their endeavour to produce clear unblemished fruit of export quality, the most favoured English districts are under the following disabilities:—

1. They have no highly-coloured keeping dessert apples of strong cropping powers at their command. Worcester Pearmain possesses many desirable qualities but will not keep very long. Cox's Orange Pippin is weak in constitution and particular as to locality. Blenheim Orange is a fine vigorous grower but too shy a cropper on young trees. Gascoigne's Scarlet and Baumann's Winter Reinette show no great evidence of coming popularity. The English growers seek as yet in vain for the equivalent of Jonathan, King David, Yates, Arkansas Black, Esoper Spitzenberg, Ben Davis, and Stayman Winesap. Attractive colour without draws the public quite as much as superior flavour within.

2. They do not obtain sufficient sun and dry air in summer (1921 being an exception and the chance of a lifetime for the

home grower to put up a good show) necessary to produce a highly-coloured fruit of long-keeping qualities. The thick skin of imported apples, though disparaged in many quarters, is nevertheless a commercial asset of no small value when one considers the long-keeping and good travelling qualities thereby conferred on the fruit. The moist atmosphere of our summer climate encourages black spot, brown rot, canker and apple mildew to an extent not met with in continental climates with bright, dry summer air. These fungi can doubtless be kept under in England, but at an outlay considerably greater than that needed in dry regions.

3. It appears to be impossible in the presence of alternative markets to get co-operative marketing associations started in England with sufficient power to command the obedience of their members under threat of refusal of their produce if it does not conform to certain standards. Marketing thus resolves itself into the efforts of the individual grower to achieve a reputation for his produce in competition with the strongly established reputation of imported brands zealously guarded by efficient State inspection.

4. Despite the valiant efforts of the small body of research workers dealing with problems relating to English fruit, much definite knowledge is still required by the home grower to enable him to produce a major percentage of his crop of the high quality of produce that comes in such huge quantities from exporting countries.

In the face of such disabilities it is perhaps hardly surprising to find that the majority show a preference for the Bramley, Newton Wonder, Lord Derby, etc.—strong-growing, heavy-cropping cookers that revel in a moist atmosphere and are easily kept free from black spot. For a Kentish orchard, Bramley, Lord Derby, Lane's Prince Albert, and Newton Wonder might be described as the grower's stand-by, that make it possible to experiment with box fruit such as Beauty of Bath, Worcester, Lady Sudely, James Grieve, Cox's Orange Pippin and Blenheim Orange.

With the help of a thorough spring lime-washing most people can grow huge crops of " rank old cookers " every other year, if not yearly in the case of Lane's Prince Albert; but the growing of box fruit must still be looked upon as the task of a highly skilled specialist with considerable capital behind him to enable him (1) to build up an individual reputation for the packing and quality of his produce, and (2) to supplement present limited

knowledge by continual experiment, more especially in spraying, thinning, and the overcoming of biennial cropping.

In recent times of scarcity the grower of quantities of cooking apples undoubtedly scored, but the future prospect of fierce competition from so many countries surely seems to warrant increasing attention to high quality keeping dessert apples—apples which need never fear a glut.

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CULTIVATION OF THE HOP CROP.

II.—MANURING.

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THE hop crop involves so many other costly operations that it is of fundamental importance to manure adequately so that a full crop may be realised; the novice will, therefore, require plenty of pluck to buy and use a sufficiency. By this it must not be assumed that manuring cannot be carried to excess, indeed this is often done with disastrous results as regards ripening, and disease; nevertheless manuring must be very heavy.

The first point to study is the soil upon which the hops are to be grown; its physical properties must be carefully studied by observation; the depth of soil and the character of the subsoil must be examined with a view to deciding the extent of the feeding area of the hop roots both for plant food and especially for water—there is little point in manuring a crop heavily when the water supply will limit the crop; finally the chemical characters of the soil—those which determine the supply of plant food—must be known; these may be ascertained chemically, provided the interpretation of the analysis is put in the hands of someone who understands both soil analyses and something about hop-growing—or ascertained by the results of manurial experience upon similar soil, or by direct experiment on the field. The items of plant food in the soil which chiefly interest the hop-grower are the same for all other crops as:—lime, organic matter, nitrogen, phosphates, potash.

The *lime* content of the soil is a matter capable of quick and easy determination by the chemist, and since it is a matter of great importance should always, except when the soil is definitely known to be calcareous or chalky, be chemically determined. The advantages of an abundant supply of free lime in the soil are many and varied; in the first place it is very beneficial to

the texture of all soils on the heavy side ; secondly, it keeps the soil "sweet" by neutralising any acids present in the soil or added to the soil by chemical manures ; thirdly, it is most beneficial to the growth of the numerous soil organisms which are concerned with the decomposition of the humus in the soil, so that its constituents may become available for plant growth. Any deficiency in lime should be made good from the outset by the application of one of the forms of lime available—ground-lime, quicklime, or chalk—according to the usual factors governing the use of lime (*See* Leaflet No. 170), and, when necessary, this soil constituent should be periodically replenished, since it is liable to rapid loss from the hop garden.

The *organic matter* is perhaps for the hop-grower the most important ingredient of the soil. Successful hop-growing depends upon keeping this at a high level for many reasons : firstly, as with lime, the organic matter plays a very important part in maintaining a good texture in the soil ; this is most important because in hop-growing it frequently happens that injury is done to the texture by operations, such as washing, having perforce to be carried out when the soil is too wet ; a soil containing a good supply of organic matter allows a good state of texture to be recovered more quickly. Secondly, a good supply of organic matter, both by helping the texture and by reason of its own properties, enables the soil to hold and retain large supplies of moisture for the hop roots. Lastly, all organic manure has been formed directly or indirectly from plant life and therefore contains within itself all elements of plant food ; these are not necessarily present in the best proportion, nor are they immediately available for the hop roots, but in the soil this organic matter is continually undergoing change by which the plant food it contains is gradually and continuously made available for plant roots. The rate of these changes is not constant, but varies according to a number of factors, of which moisture, temperature and supply of air are the most important, and since the last factor, that of air supply, is controlled by tillage, the hop grower is enabled to control to some extent the rate at which the plant food stored in the organic material becomes available. The amount of organic matter present in most soils, except recently broken old pasture, requires to be considerably augmented before it reaches the standard of fertility considered desirable for hop-growing.

Nitrogen.—Practically all the nitrogen held in soils is combined within the organic material ; a soil which is well supplied with organic material will as a general rule contain relatively large quantities of nitrogen. It has previously been stated that this organic matter is constantly—though not always at the same rate—undergoing change resulting in the production of plant food. The most important resultants of these changes are the nitrates, which are the forms in which plants absorb nitrogen as a food. Now it is important to realise that nitrogenous plant food has a specific effect upon plant growth ; it stimulates the growth of foliage—stem and leaf. If nitrogenous plant food is deficient the bine is yellowish and stunted in growth, the crop will be small ; if nitrogen is abundant then growth of foliage will be luxuriant and may result (provided other conditions are favourable) in a full crop. It is, however, possible that the supply of nitrogenous plant food, especially in a wet season, may be excessive. In this case foliage is too luxuriant and abundant, the lateral branches become matted together so that the supply of light and air are insufficient for the formation of "burr" and the growth

of the hops, while the development of the hop mould is encouraged and the difficulties of killing all the aphis are greatly increased.

It can easily be realised, therefore, that it is essential to adjust the supply of nitrogenous plant food during the growing period; a fair supply during the early season so as to produce a vigorous yet hardy and short-jointed growth to furnish the strings: an abundant supply during mid-season so that the bine may form plenty of burr and so that this may "roll" out into fine large hops; but a restricted supply when the hops are ripening so that they may develop a good primrose colour.

Phosphates are another important ingredient in all soils, and probably no soil contains a sufficiency for the intensive production of any crop. The influence of phosphates upon plant growth is not so well-defined as that of nitrogen, none the less it is known to be intimately associated with certain processes in the plant; thus it plays an important part in root development and is of great importance in the formation and ripening of flowers and seeds and consequently of the hop cones; it will be noted that these important influences are not so easily observable as the effect of nitrogen, which produces a vivid dark green colour and rapid growth, and consequently the effect of ample phosphatic manuring may be valued too lowly unless the test of weighing the crop is applied; when this is done, however, its value is generally made apparent.

Potash is generally plentiful in clay soils and deficient in light soils; on the clays little if any potash requires to be supplied beyond that contained in the frequent dressings of dung, but on light soils it is necessary to include some artificial potash in the manurial scheme.

Practice in Manuring.—Previous to planting and during the first few years in the life of a hop garden, manuring should be exceptionally heavy so as to bring the garden rapidly to a high state of fertility; this of course is especially true in the case of any element of plant food in which the soil is known to be deficient. It will perhaps be convenient to examine the manuring in the same order in which the plant food has been considered:—

Lime.—Any deficiency of lime, indicated by sourness of soil or bad textural conditions, should be remedied at once by a heavy application and the lime-content should be maintained in any garden in which this is small by repeated applications of ½ to 1 ton of quick or ground lime every fourth year; or by the application of 8 or 10 loads of chalk once in ten years.

Organic Manure.—By far the best means of increasing this constituent of the soil is by the use of farmyard manure—unfortunately it is rarely the case that sufficient can be obtained, in which case horse manure from the towns is the best substitute, and, failing this, shoddy* may be and is used in large quantities by hop-growers: where shoddy is used, it is important to realise

* *See* Leaflet No. 175.

that, unlike dung, shoddy contains no potash or phosphates and consequently applications of these must be increased.

In normal practice 20 to 30 loads of dung per acre should be applied each year during the early life of a hop-garden, or as a substitute 2 to 3 tons of shoddy. The usual time at which the dung or shoddy should be applied is during autumn or winter, to be ploughed and worked into the land, yet dung may be advantageously applied in summer provided it is properly treated —preferably it should be spread along close to the hop-hills and either ploughed under cover or covered up with soil by forks so as to prevent loss of ammonia into the air. This latter practice, "summer-dunging," is economical from another aspect; it is well recognised that dung, no matter how well it may be stored, constantly loses nitrogen. Russell* and Richards have shown that these losses may be as much as 30 per cent. during three months' storage; such loss of nitrogen falls almost exclusively on the most soluble and therefore most valuable constituents of the dung; if, therefore, the dung made during the latter part of winter is judiciously applied to the hops, this soluble and available nitrogen is converted to good use by the hop roots, and the less soluble constituents, the decaying straw, etc., are no less valuable to the soil for textural and other purposes by this method of application. It is to be remembered, however, that there is a right and a wrong time to apply dung in summer; it will do little or no good if application is delayed till August, but will give best results if it is applied so that it is available for the hop roots just before "burr" begins to be formed.

Quick-acting Nitrogenous Manure.—We have already seen that in order to obtain best results the hop plant requires to be supplied with a continuous and ample supply of nitrogenous food from the time when growth begins in the spring until the formation of the "burr" is complete. We have further seen that the application of organic manures such as dung and shoddy as well as the organic matter already present in the soil leads to a continuous, though irregular, supply of available nitrogen; this supply following the dead winter season is likely to be ample for the needs of the hop during the early stages of growth, but may not be sufficient to produce the vigorous growth required whilst the "burr" is being formed. It is, therefore, generally necessary to supplement the slowly available dung and soil nitrogen with some quick-acting nitrogenous fertilizer.

* *See* Leaflet No. 93.

One other reason may render the use of quick-acting nitrogenous manure advisable, namely, if the growth of the plant receives a check caused by severe aphis attack or a spell of cold east wind; quickly available nitrogenous manure is the most certain way of bringing the plant again into active growth.

The choice in the use of quick-acting nitrogenous manures is wide, ranging from immediately available nitrates (nitrate of soda or nitrate of lime) through such manures as sulphate of ammonia or calcium cyanamide to guanos of various kinds, organic in origin, more or less quick in action and containing larger or smaller quantities of phosphates. If the case is one in which an immediate stimulus is required, as for instance when a garden is short of bine or an attack of aphis has checked growth, then one of the nitrates should be used; if the garden is well-supplied with lime and sulphate of ammonia is cheap per unit of nitrogen then this should be used in preference to the nitrates; if the maximum effect is not required for two or three weeks, then preference may perhaps be given to meat meal or other guano because its action may be expected to be more prolonged. In general it is desirable to avoid the use of heavy dressings of nitrates late in the season to Golding hops on good quality land because this causes the cones to be coarse, especially as to the sterile bracts, but these manures may be advantageously used for Fuggle hops.

In any case such artificial nitrogenous manures should be well worked into the soil, so that they may be incorporated with the moist soil in which the roots are growing; in general the manures should be distributed evenly over the full width of the alley, but during the first two seasons before the hop roots have spread throughout the soil, better results will be obtained by spreading the manure within a few feet of the hop plants.

Phosphates.—Phosphatic manures after application are stored in the soil without risk of loss by washing, and remain available for the use of plant roots; practice in the application of these is very different from that of nitrogenous artificials. Phosphatic manures should generally be applied in excess of crop requirements during the winter or early spring season so that they may be incorporated and intimately mixed with the soil by spring cultivations. The actual choice of phosphate manure will depend upon the nature of the soil and especially upon the lime-content of the soil. If the lime-content is good then superphosphate or dissolved bone manures will generally produce bests results; if

the lime-content is poor then organic phosphates, such as those contained in the guanos, bone meal or steamed bone flour will be preferable. If the land is a heavy clay then a high-grade basic slag (low-grade slags are generally very insoluble) may be chosen, or soft-grinding mineral phosphates may be substituted.

Potash.—Potash manures like the phosphates should be applied during early spring and worked well into the land; when well-made farmyard dung is freely applied little or no potash manures are required on heavy land; but when shoddy displaces dung or the hop-garden is on light soil then potash manures must be used. There is little evidence to show which of the potash fertilizers gives best results and when small quantities only are being used the choice should rest with whichever potash salt is cheapest to apply per unit of potash. If the dressings of potash to be applied are large then the impurities in kainit may possibly act deleteriously and in that case preference should be given to either muriate or sulphate of potash.

Special Hop Manures.—A hop-grower who has a reasonable knowledge of the functions and uses of artificial manures has no need to buy special hop manures, which will always be more costly than the pure manures, no matter how glowingly the analyses of such special manures are set forth. On the other hand, when a grower desires to apply a composite mixture of manures, the help of the manure merchant may be profitably accepted, both for information as to what manures can be advantageously mixed, and for the actual mixing of them. Usually, however, mixtures do not result in much economy, as the quantities used in hop gardens are large and can therefore be accurately distributed alone.

Schemes of Manuring.—A few typical cases of manuring are appended to illustrate the standard commonly adopted by successful hop-growers.

Scheme I.—For newly-planted hops on a brick-earth loam well supplied with lime.

30 to 40 loads of good farmyard dung, ploughed into land in autumn before planting.

10 cwt. superphosphate, broadcasted in March.

5–10 cwt. fish guano or meat meal, distributed round the hills in April and carefully forked in.

Scheme II.—For newly-planted hops on stiff clay soil, deficient in lime.

30 to 40 loads of good dung, ploughed into land in autumn before planting.

1 ton ground or quick lime
and
10–20 cwt. high-grade basic slag } distributed on top of the ploughing as early as possible.

5 cwt. fish meal, or 3 cwt. nitrate of lime } distributed round hills in April and carefully forked in.

Scheme III.—For one-year old hops (half pole), which should yield ½ to ¾ of a full crop, on a loam soil, well supplied with lime.

3 to 4 tons of shoddy, ploughed into land in winter.

10 cwt. superphosphate and 2 cwt. sulphate or muriate of potash } broadcasted in March.

10 cwt. meat meal, etc., spread along slips and forked into ground in April.

2 cwt. sulphate of ammonia or nitrate of soda, broadcasted in May.

N.B.—When shoddy is used instead of dung some potash and phosphatic manure must be added if the dung is to be completely substituted; approximately 2 cwt. of sulphate of potash and 4 cwt. of superphosphate (30 per cent.) will contain the equivalent potash and phosphoric acid in 10 tons of dung (= 15 to 20 loads).

Scheme IV.—Full-grown hops on loam, well supplied with lime.

20 loads of good dung, ploughed into land in winter.

8 cwt. superphosphate, broadcasted in March.

5-10 cwt. nitrogenous organic manure (*i.e.*, fish meal), broadcasted in April.

and 1 to 2 cwt. sulphate of ammonia or nitrate of soda in May or June if hops get checked or are short of bine.

Scheme V.—Full-grown Fuggles on clay, deficient in lime.

20 loads of dung, ploughed into land in autumn.

10 cwt. high-grade basic slag, broadcasted in autumn or winter.

5 cwt. nitrogenous organic manure, broadcasted in April.

2 cwt. sulphate of ammonia or nitrate of soda, broadcasted in May.

1 cwt. nitrate of lime or nitrate of soda, broadcasted in June, and in addition to this 1 ton of lime every 4 or 5 years.

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CUMBERLAND PIGS.

SANDERS SPENCER.

ANOTHER breed of pigs which has been named after the county in which it has been largely bred for a great number of years is the Cumberland breed.* It is essentially a local production and its long-continued existence has been solely due to the fact that it completely supplies the wants of the Cumberland farmers in that it is hardy, prolific, thrives well on the somewhat exposed farms, makes the best possible use of the large quantity of dairy offals available, fattens readily, and when slaughtered

*An article on "Berkshire Pigs" appeared in this *Journal* for January last, p. 887.

FIG. 1.—A Cumberland Sow.

FIG. 2.—A Cumberland Boar.

furnishes a carcass of pork of fine quality, which on being converted into bacon is greatly in demand on those markets where quality of bacon and hams is highly esteemed, and command the highest prices current.

Of its origin very little appears to be known. It possesses several of the points of the pig common in Denmark, which goes by the name of the Land Race. In form and character it is very similar in two points, the form of the head and its length, as the head of the Cumberland pig is rather short, with an upturned snout, but in the hair it is very dissimilar, this being very fine and limited in quantity. It is generally considered that shortness of head, heaviness of jowl and sparseness of hair are indicative of excess of fat in proportion to the lean meat in most breeds of pigs, but this does not appear to be the case with the Cumberland pig, or the bacon and hams manufactured from it would not have attained and held for so many years a position amongst the highest in the provision trade. It may be possible that the production of a large proportion of lean meat and the firmness of texture of the fat portion of the carcass have become a part of the Cumberland pig's nature owing to the conditions under which it exists, *i.e.*, it has lived for many generations a hardy and open-air life, and has been largely fed on dairy offals, especially during the fattening stage. Evidence that the quality of the meat furnished by an animal is greatly affected by the life which the animal has led, is furnished by the following extract from the published report of an interview with the meat buyer for two of the principal restaurants in London :—

> "We serve a fillet of beef that is unrivalled in Europe. It is raised by a French agriculturist from bullocks that are not only fed with exceptional care, but also worked at plough. This exercise, carefully watched and regulated, gives to the flesh an extraordinarily even admixture of fat and lean, and produces a steak like no other."

The claim that acquired characteristics, whether from the system of feeding or from the conditions long continued under which the animal has lived, eventually become permanent may be said to receive support from the Cumberland pig in its present state.

In the introduction to the first volume of the herd book of the Cumberland Pig Breeders' Association extracts are given from books and treatises published in the early part of the last century. These clearly prove that the Cumberland pig of that day possessed some of the peculiar characteristics of the present-day pig, such as the rather large hanging down ear, and the smooth white skin with occasional blue spots which are not as

frequently apparent at the birth of the pig as later in life. It is thought by some persons that the Cumberland pig of olden times was a larger and somewhat coarser type of pig than that common at the present day. This refining and improvement may have been due to a certain extent to the admixture of the blood of the class of pig bred in Lancashire and North Yorkshire, and now known as the Middle White. That well-known old Yorkshire pig breeder, Mr. Mangles, informed the writer many years ago that he had sold many of the finer quality short-headed Yorkshire boars for use in Cumberland. The use of these boars may have had some influence on the size and quality of the old-fashioned Cumberland pig, but it is probable that most of the improvement in its character has been brought about by the continued care of the Cumberland farmer in the selection for breeding purposes of only those boars and sows of the form and quality necessary in the manufacture of the choicest bacon and hams for which the county has been noted for so long a time.

That the farmers and pig breeders in Cumberland are still animated by the desire to continue their efforts to place their cured meats in the highest position on the markets appears to be proved by the movement which has been inaugurated, having for its object the labelling of all Cumberland hams and bacon manufactured from pigs bred and fattened within the county, and naturally more or less of the type, form and character of the Cumberland pig, so that they are easily distinguished from hams and bacon produced from fat pigs of other breeds which have been sent into the county and there cured in order to secure that higher price on the market which is said to belong of right to the real Cumberland hams and bacon.

The standard of excellence issued by the Cumberland Pig Breeders' Association is as follows :—

Head.—Fairly short, wide snout, dished face, wide between ears.
Jowl.—Heavy.
Ears.—Falling forward over face, long and thin.
Neck.—Fairly long and muscular.
Chest.—Deep and wide.
Shoulders.—Deep and sloping in to the back, blades not prominent but in line with ribs, not too wide on top.
Back.—Long and level or with slight arch from head to tail.
Ribs.—Deep and well sprung.
Loins.—Broad and strong.
Sides.—Deep.
Belly and Flank.—Full and thick.
Quarters.—Long and level or with only very slight droop.
Tail.—Set high, not coarse.

Hams.—Very large and well filled to hocks.
Legs.—Short, straight and strong.
Colour.—White.
Skin and Coat.—Smooth, hair straight, fine and silky, and not too much of it.
Size.—Large without coarseness.
Disqualifications.—Black spots, black hair, prick ears.
Objections.—Blue spots.

* * * * * *

POTATO LEAF CURL DEMONSTRATIONS.

A. D. COTTON.

Mycologist to the Ministry of Agriculture.

IT is well known (1) that potatoes affected with the disease termed Leaf Curl or Leaf Roll suffer a very severe reduction in yield, and (2) that it is by the use of infected seed that infected crops with poor yields are produced. The necessity, therefore, of using really good seed is clear. A large amount of very careful research on potato diseases of this type has been carried out during recent years, both in Europe and America, and the results all emphasise (*a*) the necessity of preserving from infection plants grown for seed-purposes, and (*b*) the immense importance to growers of planting only absolutely healthy tubers.

With the commendable object of saving expenses, growers are often tempted to use home-grown seed instead of purchasing a fresh supply from a good seed-area. If the crop is free from disease, and especially from such troubles as Leaf Curl and Mosaic,* this course cannot be objected to, but if the two diseases mentioned are present, even in mild form, the resulting crop will develop the same trouble, and the small weight of tubers should show it to be false economy. Farmers are usually more fully aware of the importance of good seed than the owners of smaller holdings. The latter are only too ready to blame the soil or the weather for a poor yield, whereas it is commonly due to the use of infected seed. A walk round allotments in any county of England will show that the "good seed" lesson has not yet been learned.

With a view to providing a practical demonstration of the effect of Leaf Curl on the crop and the value of healthy seed the Ministry instituted trials in various centres in 1921. In order

* An account of these two diseases will be found in the Sectional Volume No. 3 (*Cultivation and Diseases of Potatoes*), price 8d., post free.

to minimise as much as possible the effect of local conditions and to render the demonstration of the widest service, the trials were located at the twelve advisory Colleges or Institutes situated in the twelve provinces into which the country is, for agricultural educational purposes, divided.

The variety selected for experiment was Arran Comrade, the seed being grown in the neighbourhood of Edinburgh, 1 cwt. of healthy seed and 1 cwt. of seed affected with Leaf Curl were sent to each College. The healthy seed was obtained from a field carefully examined and found to be entirely free from disease. The second lot of seed was from a field a few miles distant which was generally, though slightly, affected with Leaf Curl. The land here was, if anything, slightly more moist than where the healthy seed was grown. The attack on this field was so slight that some growers would probably have regarded the crop as healthy, and even by those conversant with Leaf Curl it might have been regarded as sufficiently good for seed-purposes. The following figures supplied by the Institutes show how much the yield is reduced when seed affected with Leaf Curl is used :—

Aberystwyth, University College of Wales.

	Curled.	*Healthy.*	*Diseased Yield.* (*Healthy*=100.)
Weight ...	3 cwt. 13 lb.	8 cwt. 4 lb.	43·7
No. of plants ...	463	522	

Long Ashton, Research Station, Bristol University.

	Curled.	*Healthy.*	*Diseased Yield.* (*Healthy*=100.)
Weight ...	4 cwt. 3 qr. 2 lb.	13 cwt. 6 lb.	36·5

The "take" very uniform in both plots ; Leaf Curl plot remained very stunted. No allowance for "misses" was necessary.

Reading, University College.

	Curled.	*Healthy.*	*Diseased Yield.* (*Healthy*=100.)
Weight ...	2 cwt. 7 lb.	8 cwt. 1 qr. 14 lb.	49·6
No. of plants	637	637	

Plot with healthy plants ploughed two months before planting and subsequently cultivated. Plot with Leaf Curl plants not well cultivated ; cabbage stumps left until dug just before planting. 25 per cent. added to third column to allow for this disadvantage.

Newton Abbot, Seale Hayne Agricultural College, Devon.

	Curled.	*Healthy.*	*Diseased Yield.* (*Healthy*=100.)
Weight ...	1 cwt. 2 qr. 26 lb.	5 cwt. 2 qr.	51·5

A number of misses occurred in Leaf Curl plot, and therefore an allowance of 20 per cent. has been added to third column. With a very few exceptions the curled plants produced only one potato of ware size and three or four small tubers ; healthy plants produced, on an average, four of ware size.

Wye, South Eastern Agricultural College.

	Curled.	*Healthy.*	*Diseased Yield.* (*Healthy*=100.)
Weight ...	3 cwt. 2 qr. 8 lb.	7 cwt. 2 qr. 26 lb.	46·1
No. of plants	645	645	

Cambridge, School of Agriculture.

Failure through drought.

Manchester, Victoria University.

Trials postponed.

At the following Institutes the results are estimated at yield per acre :—

Bangor, University College of North Wales.

	Curled.	*Healthy.*	*Diseased Yield.* (*Healthy*=100.)
Weight ...	6 T. 16 cwt. 2 qr. 9 lb.	14 T. 8 cwt. 3 qr. 21 lb.	47·3

On May 20 healthy plants well above ground, curled plants only just showing ; this difference in rate of growth was apparent throughout the growing season. Only two or three tubers failed to produce plants.

Newport, Salop, Harper-Adams Agricultural College.

	Curled.	*Healthy.*	*Diseased Yield.* (*Healthy*=100.)
Weight ...	6 T. 10 cwt. 3 qr. 8 lb.	8 T. 12 cwt. 2 qr. 18 lb.	75·7*

Leeds University, Garforth Farm.

	Curled.	*Healthy.*	*Diseased Yield.* (*Healthy*=100.)
Weight ...	6 T. 13 cwt. 1 qr.	11 T. 1 cwt. 1 qr.	60·2

Very few misses.

Sutton Bonnington, Midland Agricultural College.

	Curled.	*Healthy.*	*Diseased Yield.* (*Healthy*=100.)
Weight ...	2 T. 10 cwt. 1 qr. 3 lb.	5 T. 4 cwt. 2 qr. 16 lb.	48·1

Newcastle, Armstrong College, Cockle Park Farm.

	Curled.	*Healthy.*	*Diseased Yield.* (*Healthy*=100.)
Weight ...	4 T. 11 cwt.	10 T. 14 cwt.	42·1

It will be seen from the results that seed which was infected with Leaf Curl yielded, with the exception of two cases, only about one-half that given by the healthy seed, and this, it may be repeated, was from seed derived from plants which were only mildly attacked the previous season. The full figures with regard to the proportions of ware, seed and chats in each crop are not published in full on account of space, but are available for those who are interested in the subject.

It is clear from the facts given that the planting of good seed is one of the most vital factors in successful potato growing. In these lean times no grower should be careless as to this matter, and no one can afford to take risks and secure only half a crop.

* When the figures for Harper-Adams College are compared with other centres, especially Bangor and Leeds, it would appear that the healthy seed at this centre must have suffered in some way and not produced its normal crop.

THE FOOD AND FEEDING HABITS OF THE LITTLE OWL.

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FOR some years past there has been a growing opinion that the Little Owl (*Carine noctua*, Scop.) is an injurious bird against which strong repressive measures should be taken before more serious damage is occasioned.

Be this as it may, it is obvious that without a more exact knowledge of its food habits, it would be unwise to proceed to destroy a bird merely upon hearsay or because of isolated and local causes of injury.

In order, therefore, that there may be some solid ground upon which to act, an investigation was commenced in 1918 with the object of obtaining specimens of this bird from numerous districts in Great Britain, throughout the different months of the year, and over two or more successive years, and to estimate the food by the volumetric system; further, to study the nature of the food fed to the nestlings and eaten by the parent birds during the nesting season, and to inquire if there was any variation in the nature of the food in different districts and seasons.

The Introduction and Spread of the Little Owl.—Most of the recorded occurrences of this species before 1843, as an occasional immigrant to the British Isles, are open to doubt. They have already been dealt with by Coward (7)* so I need not repeat them here.

In 1842 Waterton made an attempt to establish this bird in Yorkshire. In his *Essays of Natural History* he recounts how he saw them in the market place at Pantheon, Italy. He says that the bird "is much prized by the gardeners of Italy for its uncommon ability in destroying insects, snails, slugs, reptiles, and mice. There is scarcely an outhouse in the gardens and vineyards of that country which is not tenanted by" this species. Thinking that it "would be peculiarly useful to the British horticulturist" he determined to import some of these birds, and after losing six specimens on the voyage and another soon after landing, he successfully introduced five birds. "On the 10th of May, 1842, there being an abundance of slugs, snails, and beetles on the ground, I released them from their

* These figures within brackets indicate references to literature to be given in the concluding part of the article.

long confinement. . . . At seven o'clock in the evening, the weather being serene and warm, I opened the door of the cage. The five owls stepped out to try their fortune in this wicked world."

While we have no proof that these specimens actually established a colony, there is every likelihood that the birds wandered away and nested.

The late Lord Lilford (15) at various times previous to 1889 liberated specimens at Lilford, near Oundle, Northamptonshire, and Mr. E. G. B. Meade-Waldo introduced specimens at Stonewall Park near Edenbridge, Kent, about 1874. Both of these introductions were successful. Finally, about 1890, and again in 1905, Mr. W. H. St. Quintin turned out some specimens at Scampston Hall, Rillington, Yorkshire, " but they did not do well, and have now apparently disappeared " (15), as also specimens released at Tring by Lord Rothschild.

From these various centres the Little Owl has spread all over the country, having been recorded from no fewer than 36 English counties, 6 Welsh, 2 Scotch, and 1 Irish.

This bird has undoubtedly proved a most successful colonist, for it has not only spread itself over the whole of the country, but it has increased in a remarkable manner.

Field Investigations.—In an investigation of this kind it is very important that the evidence from all quarters should be carefully considered before arriving at any conclusions. In this connection, therefore, observations made in the field are very desirable. It is important, however, that such observations, if they are to be of any value, should be made by those who know the Little Owl and are not liable to confuse it with other species, which is not infrequently the case.

Abundance.—There is now considerable evidence to show that the Little Owl is fairly abundant in most parts of England, and that it is slowly spreading to Wales and further north into Scotland. It is said to be " By far the commonest owl in Bedfordshire "* as many as 20 being seen together in small spinneys, and is recorded as " very common " in Hertford, " Fairly common and plentiful " in Leicester, Northampton, Kent, Devon, Dorset, Somerset and Wilts., " Becoming numerous " in Lincolnshire, Yorkshire and Herts., " Have greatly increased since 1914 " in Sussex and Essex. A correspondent writes from Suffolk that during 1920 there were twice as many as in 1919. Another states that on one estate in

* Atchison, G .T., Brit. Birds, 1912, p. 66.

Leicestershire 30 specimens were shot in 1919, while on an Essex estate 24 young birds were hatched in 1920.

Rate of Increase.—Reliable information as to the rate of increase of the Little Owl in different districts has proved somewhat difficult to obtain. Many of the statements are obviously only surmises and not based on actual observation. In a few instances, however, the actual nests have been counted. Many correspondents remark that the full brood of 4, 5, or 6 are all reared, and that the young birds are peculiarly alert.

Assuming then that a pair of birds annually produce four young, half of each sex, and that all live, together with their offspring, in six years the progeny of a single pair would be 1,458 (cf. Table).

TABLE I.—Showing the annual increase and total number of Little Owls, the progeny of a single pair, in successive seasons for six years, assuming that all lived.

Years.	*Number of pairs breeding.*	*Number of pairs of young.*	*Total number of pairs.*	*Total number of birds.*
1st	1	2	3	6
2nd	3	6	9	18
3rd	9	18	27	54
4th	27	54	81	162
5th	81	162	243	486
6th	243	486	729	1458

On a rough computation of this kind, it is clearly evident that we must have in this country at the present time quite a large number of individuals. Supposing, however, that we put the number in the sixth year at a sixth of 1,458,, *i.e.*, 243, and assume that in 30 English counties there are in each 10 pairs of birds to begin with, then we have a total of 72,900 in the sixth year.

The natural checks to increase in this case are few. All the specimens that I have examined have been particularly well nourished, free from disease, and remarkably free from ecto- or endoparasites. The Little Owl would seem to be a particularly hardy and healthy bird, and very accommodating in its diet.

In the autumn there accumulates immediately beneath the skin, especially on the back and on the under side of the abdominal region, a thick layer of fat, which undoubtedly serves as a reserve food store. Moreover, of the 194 specimens examined, in only two have the stomachs been entirely empty.

Birds kept in captivity for 8 and 9 days and only supplied

with water did not appear to suffer at all, and only indifferently regarded earthworms, beetles and raw flesh, when placed in their cage. Correspondents speak of it as being able to subsist for a long time without food, but on this point I have no other evidence than the case here recorded.

Nesting and other Habits.—The nesting site may be in old buildings, the roofs of farm and other buildings, quarries, hollow trees and rabbit holes. Old willow stumps are often frequented, the site being only 3 or 4 feet from the ground. No nest is made, the eggs being laid on the bare wood or ground, very occasionally a few feathers or fragments of pellets forming a base.

Late in April or in May from 3 to 5 eggs are laid, though 6 and 7 have been recorded. The eggs are perfectly white and of a short oval form. Both male and female take part in incubating the eggs. The young birds remain in the nest for about 25 or 26 days, after which they can fly quite well, but for some little time they keep to the same tree in which the nest has been or one adjacent to the nesting site.

Dresser (8) quotes a statement by J. O. Keulemans as follows:—

"The Little Owl is very abundant all over Holland, especially in these localities where meadows with large bushes are found. In such places one sees extensive farmyards, which generally have an orchard at the back. These the Little Owl appears to frequent by preference, and seldom do such spots remain untenanted by these small birds of prey. I have often seen as many as six within an hour at different spots, so common are they. They are more often seen about the hour of twilight during the months of September, October and November, when migrating birds visit the country. They are frequently observed to fly long distances in the open fields in the daytime, rarely, however, without being pursued by a swarm of clamorous Starlings, House-sparrows, or even Crows and Magpies. Swallows also exhibit great aversion to this Owl, for no sooner do they spy one than a multitude assemble and fly round about it, chasing it from one spot to another."

"In Holland the bird is universally well known. They do not seem to drink much, as I have had them in a cage for more than a year without giving them any water. Indeed it is a curious fact that when they get wet, either by heavy rain or by being placed in a damp spot, they have fits and remain insensible for hours, and sometimes it causes their death. I had one once which I had placed on a boat near the bank while I was catching birds. The Owl saw its image reflected in the water and jumped in; and although I took it out immediately it was quite insensible, and to all appearance dead. Much regretting its loss, I put it into my pocket and carried it about for two hours, and on reaching home threw it down in a corner of the room. Hearing a noise in the middle of the night I went down, and to my great delight found my Owl jumping about on the table."

Although frequently seen about in the daytime, when it is heavy and stupid and not like the same bird, the Little Owl is most active after sunset and in the early morning before daybreak.

It is a remarkable ground feeder, getting over a considerable amount of ground and picking up practically all insect life that it meets with. At dusk it may be seen sitting on a post or tree trunk every now and then making short low flights often quite close to the ground. It will also search over the larger branches of trees for insects.

During the nesting season earthworms are largely taken for the young.

Opinions of Correspondents, etc.—The following notes from correspondents are of considerable interest :—

From A. A. C. (Suffolk).—"The Little Owl may do damage to game, but from my own observations I have thus far no evidence of that. We have a good head of partridges. One nest I found was on one of two isolated trees near a wood ; game here and around was as plentiful as elsewhere. As far as I can prove, they are beneficial."

From C. M. A. (Surrey and Cambridge).—"At all the breeding haunts I have visited I have never found remains of either game birds or poultry, and one nest was within a few hundred yards of a farm" . . . . . where there were "young chickens, ducks, and guinea fowl."

From G. P. (Monmouth).—"Although I cannot prove any criminality against them, they have a terrifying influence over game, and I have noticed particularly an entire absence of snipe in the locality they frequent."

From G. F. N. (Northamptonshire).—"I have found them very destructive among young pheasants. I once saw one take a pheasant about a week old and disappear into a hole in a tree. I shot it when it came out. I enlarged the hole and found eleven young pheasants and one wild duck a few days old and four young owls."

From A. H. B. (Somerset).—"I feel sure this wretched Little Owl, which never ought to have been introduced, must do a lot of harm. It looks far too innocent by day. I have often watched it, but cannot catch it red-handed."

From S. S. (Dorset).—"I cannot say that I have actually seen the Little Owl do any damage to partridge."

From G. K. (Northamptonshire).—"The Little Owl is very plentiful here and increasing. In their 'larders' I have found adult starlings, house-sparrows and other small birds, also bank voles and long-tailed field mice, but I have never seen any game. It may occasionally take a chick, but I have no proof. Their pellets contain large numbers of beetles."

From C. L. J. (Lincoln).—"I have seen them strike and carry off young pheasants and have found remains of young pheasants in and near the nests. I have never seen it attack adult game birds . . . They destroy a great quantity of rats, mice, and voles."

From C. R. (Essex).—"We have had Little Owls here for many years, and although there is plenty of game I have no actual proof that they destroy

it. In the 'larders' I have found young and adult starlings, chaffinches, house-sparrows, bank-voles, long-tailed field mice, one young rabbit, rats, and remains of frogs."

From J. C. L. (Hertford).—"We certainly lose a few young game birds each year due to the presence of the Little Owl, but I should not like to condemn it on that account, for considering the number of injurious insects, voles, rats and mice that it destroys practically during every month of the year, I consider it does far more good than harm. I have examined large numbers of its pellets and the evidence they provide is all in favour of this quaint little bird."

From R. B. C. (Suffolk).—"I cannot think they do much harm to game, as this has been quite a good partridge year, and I live on one of the great shooting estates. On the whole I think the case against the Little Owl is mainly one of 'giving a dog a bad name,' though I daresay they do sometimes take young game birds."

From G. H. G. (Sussex).—"I consider it is very harmful."

From W. H. H. (Essex).—"I am of opinion that the natural food of this bird is insects and larvæ in season, and small birds, etc., during the winter. I personally destroy this bird when chance occurs, as I think it harmful to poultry and young partridge."

From W. S. M. (Lincolnshire).—"I do not know of any case myself of injury to game birds; there are plenty of keepers who will swear to it, but that is not proof."

From F. H. (Kent).—"I have never seen them injure game birds."

From H. O. P. (Leicester).—"I consider it quite harmless except during the nesting season. The bird is so small that it can get right into the coops and peck out a small partridge or pheasant, and its habit is to walk quietly up, consequently the old hen pays little attention to it, whereas a hawk arouses the suspicions of the hen foster-mother. They work by day and night. I have had complaint from local farmers that they come and remove chickens. Personally I have stopped the shooting of them and the keepers must watch their coops carefully during those three weeks or month."

From J. E. K. (Devon).—"So far as my own investigations go I have not yet found anything in those I have examined but beetles, a little moss or grass, and in the last one a few very small stones."

From C. T. F. (Middlesex).—"From what I have observed, I have come to the conclusion that the Little Owl is not to be feared. His favourite haunt here is in pollards growing alongside a ditch and I suspect that his favourite meal is a water rat. Judging by the number of partridge found this season I don't think the Little Owl can be harmful to them."

From H. J. F. (Hertford).—"My opinion (framed on facts) is the Little Owl *in the breeding season* does much harm to young game. After the young have flown, I personally have found very little trace of their damage to game."

From H. (Oxford).—"My experience of the Little Owl is that they are most destructive to young game birds, especially partridges, working as they do in the daytime. I am over-run with them here."*

* On this estate 200 Little Owls were killed in 1920, and 23 in one shoot.

Depredations.—Numerous very serious charges have been made against the Little Owl: thus a recent writer (1) states: "The large amount of damage done by little owls to poultry and game has set all the gamekeepers and many others against it."

A large number of letters received from gamekeepers charge this bird with the destruction of young pheasants, partridges and fowls, also wild ducks and wood pigeons. Other correspondents have recorded the presence in their "hoards" or larders of the starling, blackbird, song-thrush, house-sparrow, chaffinch, greenfinch, linnet, skylark, cuckoo, bank vole, long-tailed field mouse, common shrew, rat, mole, rabbit, bat, snake and frog.

Some little time back this bird was reported to me as having been seen to carry off young pheasants. This occurred so often that the keeper shot the bird and sent it to me, but instead of an owl it was a sparrow hawk.

Mr. Meade-Waldo (12), who has paid considerable attention to the food of Little Owls, writes: "They are very large consumers of insects, beetles, earthworms, lizards, mice—and during the time the young are being fed, kill a great many birds. These consist almost entirely of young thrushes, blackbirds, mistle-thrushes, sparrows, chaffinches, greenfinches, some skylarks—just what one might expect; but the main point comes in the fact that, in all these years I have never *seen the remains of a single game-bird in a nest or 'hoard.'*" Later he writes (*In litt.*, 3 x 20): "We do not find them doing any harm now. All their castings consist of insect remains, beetles, etc. They hawk daddy longlegs, etc., all day and also at night, and we none of us found the remains of any young game birds in any nests that we carefully noted last summer. . . . I have had no complaints of chicken killing this year, and there are Little Owls in every farmstead."

Dresser (8) quotes Mr. Robson as stating that in Turkey and Asia Minor "It feeds much on the ground, principally subsisting on small beetles," and again De La Fontaine, that in Luxembourg "It feeds on small birds, mice and other small rodents, moths maybugs, etc. It is undoubtedly a most useful bird."

Mr. J. H. Gurney (10) writes: "There seems to be a prevailing prejudice against it, but the harm it does has been greatly exaggerated, in spite of what numerous letters to sporting papers may say to the contrary; at any rate, in the

south of France it is not looked upon with disfavour, and the test of dissection is rather in its favour than otherwise."

Atchison* records finding 74 young pheasants in a nest on a Cambridgeshire estate.

In reply to a circular letter sent to various correspondents, gamekeepers, etc., 23 state that in their opinion this bird is more injurious than beneficial, and 26 state it is more beneficial than injurious, while 28 state they do not know of any injuries.

Apart from the observations of Mr. Meade-Waldo, quoted above, none of these examinations are complete or extensive enough to affect the question, for we have an equally convincing series of opinions and isolated observations from both sides.

It is obviously wrong to condemn any species of bird because it destroys a certain percentage of young game birds, just as it would be to condemn another species because it destroys a certain percentage of cereals or fruit.

The question that lies before us is not whether the Little Owl destroys young game birds, but whether the percentages of other food items confer a benefit out of all proportion to the loss inflicted. In other words, we must have accurate figures showing the percentages of all the food items, for each month of the year, based upon a large series of stomach contents and pellets obtained from various localities, and such is the work we have endeavoured to carry out.

Migrations.—Many correspondents state that the Little Owls leave them, or almost so, during the winter months. In Leicester they are recorded as plentiful in the summer, but with the coming of autumn they mostly disappear, not returning until the end of April or early May. In Yorkshire they certainly move south with the return of winter.

A Lincolnshire correspondent writes (12th October): "Little Owls seem to have disappeared from this neighbourhood during the last six months. All the keepers, about ten, round here have had instructions from me to bring in any they caught, but not one has been seen."

Relation to other Wild Birds.—In considering the economic position of a bird like the Little Owl, it is highly important that attention should be given to the actual kinds of wild birds which it destroys and the percentage these bear to the total food bulk.

* Brit. Birds, 1912, p. 66.

The following list* includes the names of all the species destroyed of which I have reliable evidence :—

Species.	*Percentage destroyed.*
House-Sparrows	2·50
Mistle-Thrush	·50
Song-Thrush	·50
Blackbird	·60
Starling	2·25
Chaffinch	·55
Greenfinch	·45
Skylark	·25
Cuckoo	·20
Lapwing	·20
Wood-Pigeon	2·25
TOTAL	10·25

Of the eleven species there is only one that is wholly beneficial, viz., the lapwing; the cuckoo and skylark are partially so, while of the remaining seven there are undoubtedly too many at the present time, and 2 of them—the house-sparrow and wood-pigeon—must be regarded as distinctly injurious. I think we may therefore conclude that so far as the Little Owl is concerned in its destruction of wild bird life it constitutes a natural check upon a series of birds all of which are plentiful, and, as a whole, are not particularly beneficial. Its activities in this direction we may therefore regard as being beneficial.

I have no complete figures for the blackbird or cuckoo, but of the remaining species the food percentages are as follows :—

	Injuries.	*Benefits.*	*Neutral.*
Mistle-Thrush	21·00	35·50	43·50
Song-Thrush	17·00	37·00	46·00
†Greenfinch	22·00	6·50	71·50
House-Sparrow	62·75	12·50	24·75
Chaffinch	18·00	16·50	65·50
Starling	41·00	36·50	22·50
Skylark	13·00	36·50	50·50
Wood-Pigeon	62·00	1·50	36·50
Lapwing	—	70·00	30·00
Average	28·53	28·05	43·42

This table should be interpreted in the light of that above, in which the percentage of the different species destroyed is shown.

* Computed from the results obtained by an examination of stomach contents, pellets, and "hoards" or "larders."

† Approximate figures only.

Natural Enemies.—The two great enemies of the Little Owl are the gamekeeper who recklessly destroys everything but game, and the egg-collector. Of other enemies the bird has few, though it is frequently mobbed by house-sparrows and other birds.

(To be concluded, References to literature will be given in the concluding article.)

* * * * * *

HULL AND DISTRICT ALLOTMENTS ASSOCIATION LIMITED.

W. N. Evans.

The allotment-holders' difficulty of security of tenure is about to be permanently solved for several hundred men in Hull by the Hull and District Allotments Association, Ltd. This Association, which has for its object the buying of land for allotments, owes its creation in 1920 to the enthusiasm and keenness of a few allotment-holders.

These men—who are mainly of the working class, and also several men who hold positions of responsibility with local business firms—had for some time discussed the question of purchasing land, and in June, 1920, a piece of land suitable for allotments came on to the market. This land was reasonable in price, but of much larger acreage than the Association required, being 21½ acres. They only wished to buy ten acres. The owner would not divide, so in the end they agreed to purchase the whole 21½ acres. The deposit money was raised amongst themselves. One must admit that these few men shouldered a great responsibility when, in June, 1920, they undertook to find by February, 1922, between £4,000 and £5,000 from an association of allotment holders not yet formed and without a penny of capital.

The Association was registered, and all people interested were invited to take up £1 shares, 2s. 6d. being payable on allotment with calls of 2s. 6d. per share every three months. Some people purchased the shares outright. The response to the appeal for subscribers was good, and to the present time the number of shareholders has steadily and continuously increased month by month. Propaganda work is carried out by the Chairman, Secretary and different members of the Committee, who visit the Allotment Societies in the city and district and explain the whole scheme to the allottees present. So far the Association

has only bought the one parcel of land mentioned above, situated on the Cottingham Road, Hull, of which possession will be taken in February, 1922.* As shareholders have come forward from all parts of the city, so also have come definite and insistent demands for the association to provide them with land. At the present time the Association is negotiating for more land, but they are proceeding with caution, as a policy of hasty purchase might easily land them in a difficult position. They are affiliated to the Agricultural Organisation Society whose model rules they adopted. The whole affair is run on as economical lines as possible. The Secretary and Treasurer (a combined post), the Chairman, and Committee, give their services gratis and also pay their own incidental expenses when attending meetings or addressing Allotment Societies, etc.

The greater part of the land has been planned out in the following approximate number of plots :—

136 plots of 300 sq. yards.
74 „ „ 400 „ „
8 „ „ 600 „ „

It is situated within five minutes' walk of the trams. This is a great consideration for allotment-holders as it makes their plots available without the waste of time involved in walking a long distance. The object of the Association is to buy land for allotments and not for building purposes, but as part of the present purchase abuts the Cottingham Road, which is in a residential district, it is ideal for building. Therefore the Association are offering the 600 yard and 400 yard plots as building plots, but the 300 yard plots can never be built on.

The prices charged for the plots are as follows :—

300 sq. yd. plots at £15 15s. 0d. per plot.
400 „ „ „ „ 1s. 6d. „ sq yd.
600 „ „ „ „ 3s. 0d. „ „ „

All purchasers must become shareholders. The Association arranged a scheme whereby members who wished could pay weekly sums on account, so that when they take over their plots in February, 1922, some will only have a small balance to pay. Many have taken advantage of this arrangement.

When the land had been planned out, a meeting of shareholders was called and different methods of allotting the plots to would-be purchasers were discussed. It was agreed to distribute on a mutual agreement basis. Each prospective buyer was to say which plot he would prefer, and if two or more men wanted

* Since the article was written the Association has completed negotiations for the purchase of 8½ acres of land situated on the Anlaby Road, Hull.

the same plot they were to settle the matter amongst themselves. This plan worked admirably. It had advantages over balloting inasmuch as it allowed friends to have plots adjoining each other (and on the other hand two men who could not agree could get away from each other); also a certain number of the 300 yard plots are directly at the rear of some of the 400 yard ones, therefore the plan of distribution allowed a man, who so wished, to buy a 400 yard plot for building purposes and have a 300 yard allotment immediately adjoining it.

The demand for plots has exceeded the Committee's most sanguine hopes. In fact, in the first instance they had reserved a piece of land adjoining the permanent allotments for " cutting up " in the future, but the demand has been such that they have already divided part of this reserve piece.

The question may be asked " What will happen to the Association when they have satisfied the demand for permanent allotments? " I asked them this question and briefly the answer was that they have in mind a scheme for supplying their members and the general public with all allotment requisites—seeds, " seed " potatoes, fertilisers, etc.,—in short, becoming a general allotment trading concern. If the Association does not attempt something on these lines, it must either spread its efforts over a continually widening area, or wind up, as one cannot continue indefinitely supplying permanent allotments to a small section of the community.

The successful launching of the whole scheme is due to the untiring energy of the Chairman, Secretary and Committee. I am sure that those who now, and in the future, become owners of permanent allotments through the instrumentality of this Association, will never appreciate to the full the amount of time and labour these officials have given; also the great responsibility they have taken with the sole public-spirited aim of benefiting the allotment-holder by solving the vexed question of security of tenure.

Ministry's Exhibit at the National Utility Poultry Society's Show.

THE Annual Show of the National Utility Poultry Society, held at the Horticultural Hall, Westminster, on December 6th-8th last, was opened by the Ministry's Permanent Secretary, Sir Francis Floud.

The Ministry's exhibits were divided into three sections, devoted mainly to educational propaganda in connection with poultry, rabbits and goats. They attracted a constant stream of visitors, and two technical officers of the Ministry who were in constant attendance at the stand throughout the show dealt with a large number of inquiries on various matters in connection with the keeping of poultry and small live stock. Sir Stewart Stockman, M.R.C.V.S., the Ministry's Chief Veterinary Officer, attended at intervals for the purpose of consultation by poultry keepers on questions of disease, and also gave an address on the same subject to a large audience in the Lecture Hall.

Among the exhibits (*see* Fig. 1), were charts giving particulars of :—

(1) Imports of Eggs and Poultry into the United Kingdom,
(2) Exports of Eggs and Poultry from Ireland (mainly to England),
(3) The Ministry's Egg and Day-old Chick Distribution Scheme.

An exhibit of exceptional interest, which was kindly lent by Principal Foulkes of Harper-Adams College, consisted of two live Wyandotte hens, in separate cages. These birds had given actual egg records of 285 and 91 respectively at the Harper-Adams College Laying Trials in 1919, and the object of the exhibit was to enable visitors to compare the visible characteristics of a typical good layer with those of a bad one. The difference between the two types shown was very noticeable, and provided a useful object lesson.

*Egg and Day-old Chick Distribution Scheme.**—By means of a map showing the situation of Egg and Day-old Chick Distributing Stations in England and Wales during the season 1921, visitors were able to note the extent to which different counties had adopted the scheme. One of the conditions of the scheme is that a poultry instructor must be employed by the County Education Authority in order to ensure that the conditions of the scheme are duly observed. Tables were also displayed showing the number of stations, and eggs and chicks distributed, in 1919, 1920 and 1921.

Early Elimination of Surplus Cockerels.—A very interesting exhibit showed the results of Professor Punnett's research work into sex inheritance. By crossing certain pure breeds of poultry which carry known Mendelian factors the sex of the chicks may be identified at the date of hatching.

* Particulars of the Egg and Chick Distribution Scheme are contained in Leaflet 374/T.E. Copies may be obtained on application to the Publications Branch, Ministry of Agriculture, 10, Whitehall Place, London, S.W. 1.

FIG. 1.—The Ministry's Exhibit at the Show of the National Utility Poultry Society.

FIG. 2.—Models of Poultry Houses and a Goat House.

Models of Poultry, Duck and Goat Houses.—The models illustrated in Fig. 2 were also exhibited. They were designed to show how the stock can be housed under the most hygienic conditions, having due regard to soundness of construction and economy of space and material.

The Backyarders Intensive House (No. 3) is fully described in Leaflet 369 entitled "Backyard Poultry Keeping."*

Market Gardening combined with Poultry Keeping.—A diagram showing a suggestion for cropping a quarter of an acre divided into four parts, on which poultry are run in turn for three months whilst crops are being grown on the other three, was the centre of much interest, and many inquiries on the subject were received.

Rabbits.—Charts showing Imports of rabbit skins (Dressed and Undressed) into the United Kingdom for the years 1913, 1920 and 1921 were displayed. The quantities and values are as follows:

	Quantities.			Values.		
	1913	1920	1921	1913	1920	1921
Dressed	2,865,649	4,134,215	4,654,281	£116,164	£514,860	£341,409
Undressed	73,342,714	39,415,976	32,696,691	£701,440	£1,588,479	£666,978

A fine selection of prepared skins of the more important fur breeds of rabbits, and articles manufactured therefrom, were also shown. These were kindly lent by individuals and organisations commercially engaged in the production and sale of fur from home produced rabbit skins. It is interesting to note that such good prices as the following were being realised for articles made from first-class rabbit pelts:—Child's coat of "Blue Beveren" (silk lined), £8 8s. 0d.; "Havana" Stole, £12 12s. 0d., and muff to match, £5 5s. 0d. Other articles on view were purses, slippers and gloves, all made from rabbit fur.

Three specimen live rabbits were shown—Chinchilla, Havana, and Blue Beveren. The beautiful quality and texture of the fur of these animals were much admired by visitors.

Goats.—Photographs of prize winning milch goats were accompanied by literature and charts on the subject. Samples of goat's milk and cream were supplied. A model of a house for two goats and a fodder store was shown (*see* Fig. 2). Full particulars as to construction, etc., will be sent on application to the Ministry.

* Copies of the working drawings of the full-size houses represented by models No. 1 to 5 may be obtained on application to the Publications Branch of the Ministry, 10, Whitehall Place, S.W.1, price 4d. each post free, or the set of 5 for 1s. 6d. post free.

NOTES ON MANURES FOR FEBRUARY.

E. J. RUSSELL, D.Sc.,
Rothamsted Experimental Station.

Influence of Manures on "taking" of Clover Seed.—The past season has strikingly shown the effect of fertilisers on the "taking" of clover seeds. Eight different manures are tested each year on the Little Hoos rotation field at Rothamsted: last year clover was sown in the barley. As usual last season, the plant failed over much of the field, but the extent of failure was considerably influenced by the manure given to the previous crops. No manure was given to the clover. The seed was sown in April. The results were as follows:—

Fairly good plant:—after farmyard manure applied to previous crops, after bone meal, and to less extent after basic slag.
Poor plant:— after superphosphate, rape cake or shoddy applied to previous crops.

The results confirm previous experience here in showing the special value of farmyard manure for the clover plant. It appears that addition of farmyard manure to the crop preceding the clover favours the development of the plant and increases its yield. Non-acid phosphates are also beneficial.

Amount of Potash removed in Meadow Hay.—A correspondent asks how much potash is removed in meadow hay and what quantity of sulphate of potash or muriate of potash must be added to replace this amount? A 1½-ton crop of meadow hay contains about 50 lb. pure potash (K_2O) which would be supplied by 92½ lb. pure sulphate of potash, or 103 lb. sulphate of potash of the 48.5 per cent. grade, or 100 lb. muriate of potash of the 50 per cent. grade.

Amount of Phosphate and other Constituents in various Crops.—In continuation of the list given in the December Notes (p. 833) a correspondent asks for a similar list for phosphates, nitrogen and lime. The data for phosphates are:—

Phosphates removed as P_2O_5 (lb. per acre).

Yield per acre.		*In grain.*	*In straw.*	*Total.*	*Equivalent to 30 per cent. superphosphate, lb. per acre.*
Wheat ...	36 bush.	17	8	25	184
Barley ...	40 „	16	5	21	154
Oats ...	50 „	15	7	22	162
Clover hay...	2 tons	—	—	25	184
Meadow hay	1½ „	—	—	12	88
Swedes ...	14 „	Roots only		17	125
Mangolds ...	30 „	„ „		49	360
Potatoes ...	12 „	Tubers only		43	316

The table shows the large amounts of fertiliser material removed from the soil by crops of the specified size, which, though good, are by no means excessive. Stated in terms of phosphoric oxide (P_2O_5) the figures do not seem imposing: they become much more striking, however, when expressed in the more familiar units of 30 per cent. superphosphate.

In the case of phosphates and of potash, removal in the crop is the most important source of loss from the soil, there being no significant washing out by rain, etc. In the case of nitrogen and of lime, however, removal by the crop is only one source of loss, drainage water removing much more serious quantities than of potash and phosphates. As against this, however, the clover crop returns a large and usually unknown amount of nitrogen to the soil. The crop figures are therefore of less importance since they represent only one of the three determining factors: they are, however, given here for the sake of completeness:—

Nitrogen removed: lb. per acre.

	In grain.	*In straw.*	*Total.*	*Equivalent to sulphate of ammonia (20% nitrogen).**	*Lime removed: lb. per acre. as oxide.**	*as carbonate.**
Wheat	41	19	60	300	11	20
Barley	35	14	49	245	9	16
Oats	38	20	58	290	13	23
Clover hay	—	—	98	490	90	160
Meadow hay	—	—	49	245	32	57
Swedes	Roots only		70	350	20	36
Mangolds	„ „		112	560	18	32
Potatoes	Tubers only		92	460	7	12

Although they represent only one source of loss the figures show that the exhaustion of nitrogen from a cropped soil is considerable, and they emphasise the need of ample nitrogenous manures for arable crops.

The large amounts of lime removed from the soil by clover and by meadow hay should be noted.

Spring Dressings for Cereal Crops.—The above table shows the demand for nitrogen made on the soil by a cereal crop: it is not surprising that nitrogenous top dressings give increases in yields. Some of the results obtained during the past season at Rothamsted are:—

Barley.

	Head corn bushels per acre.	*Total grain lb. per acre.*	*Straw cwt. per acre.*	*Total produce lb. per acre.*
No top dressing ...	25·6	1,554	17·1	3,473
Top dressing (sulphate of ammonia) ...	34·2	2,056	22·8	4,612

* See p. 832 for explanation of difference between these.

Thus in spite of the drought the barley responded satisfactorily to the nitrogenous dressing.

The results for wheat were not so marked; although there was an increase in crop it barely paid the cost of the dressing. Some of the figures are :—

Wheat.

	Head corn bushels per acre.	*Total grain lb. per acre.*	*Straw cwt. per acre.*	*Total produce lb. per acre.*
No top dressing ...	17·4	1,507	22·6	4,040
Top dressing (sulphate of ammonia) ...	18·6	1,605	25·8	4,497

Use of Ashpit Refuse as Manure.—The variable nature of this material and its dependence on season is shown by a recent delivery of London refuse which was found to contain more cinder than that delivered in the summer. During the hot weather household refuse appears to be poorer in cinders and therefore richer in fertiliser material than in winter.

Further information as to some of the northern towns' refuse has been supplied to the writer by Mr. R. W. Wheldon, of the Agricultural Department, Armstrong College, Newcastle-on-Tyne. At Cockle Park town refuse did not give as good results as farmyard manure when both were used at the same rate of 15 tons per acre, the crops of swedes being 25¼ tons with farmyard manure and 21½ tons with Gateshead refuse. It is possible, however, that the dry weather (which was felt even at Cockle Park, although one would not have imagined it from the yield of swedes) was not favourable to the town refuse. Elsewhere it gave satisfactory results on potatoes, and many farmers speak well of this particular material. It is offered at Gateshead at 2s. 6d. per ton and is cheaper than town stable manures. It is, however, richer in nitrogen than is generally the case, some samples containing up to 1 per cent. of this important fertiliser constituent.

Other ashpit refuse materials from towns are as follows :—

Percentage Composition.

	Tynemouth.	*Bury.*
Nitrogen	0·50	0·55
Phosphoric Acid (P_2O_5)	0·19	0·67
Equivalent to Ammonia	0·60	0·33
Equivalent to Tribasic phosphate of Lime ...	0·41	0·72
Potash (K_2O)	0·30	—
Organic matter	—	13·6
Mineral matter	—	52·0

Electric and Radium Fertilisers.—From time to time correspondents raise the question whether any particular value is

conferred on fertilisers by electricity or radium. There is no evidence that either of these agents increases manurial values, and farmers should not pay more for any fertiliser than is warranted by its chemical composition. It is easy to calculate from unit prices a fair value for an artificial manure, and anything paid in excess of this must be regarded as a speculation which may not justify itself.

* * * * * *

NOTES ON FEEDING STUFFS FOR FEBRUARY.

E. T. HALNAN, M.A., Dip. Agric. (Cantab.).
Ministry of Agriculture and Fisheries.

Winter Feeding of Live Stock when Roots are scarce.—Arising out of a previous article (November, 1921, p. 725) several correspondents have written giving their practical experience. The two following extracts from letters received illustrate two methods of overcoming the difficulty, and are included here, owing to their practical interest.

Wintering Store Cattle with little or no Roots.—(1) "On a very light-land farm where I cannot grow any quantity of roots, I have been accustomed to winter 40 10-cwt. store bullocks. In 1919 they were fed on 2 lb. each decorticated ground nut cake and 2 lb. each linseed cake with barley straw, *ad lib.*; in 1920 a similar lot were fed on 4 lb. linseed cake and barley straw."

The method of feeding was as follows:—

"The cake was fed to the bullocks at 7 a.m., and then the mangers and racks filled up with barley straw and no other attention given until next day. Of course a plentiful supply of water was at hand. This method of wintering is cheap as regards labour, and from my experience successful.

"My experience of using treacle is not in its favour as I found it scoured the bullocks when given in only small quantities.

"This winter on another farm I am trying to fatten 40 9-cwt. to 10-cwt. bullocks on 4 lb. bean meal, 1 lb. ground nut cake, and 3 lb. linseed cake."

(2) Another correspondent writes:—

"This year I have been confronted with the difficulty of finding a method of feeding to compensate for the shortage of roots, as we have only half our usual crop. I have done this by substituting linseed and treacle, and I find it works out admirably.

"I have gone carefully into the day's mixing for the whole of the food. We do this one day for the next, so that the food stands in a heap 24 hours. We boil the linseed in a large copper, enough for three days each time of boiling.

"The treacle is mixed in cold water and thrown on the top of the food just before mixing. We use probably 25 buckets of water or so in the linseed and treacle altogether.

"The daily heap consists of:—

32 st. Straw chop.
12 st. Swedes.
12 st. Ground corn (wheat and oats).
6 lb. Linseed.
12 lb. Treacle.

"This heap is for 50 beasts. Each beast gets a server full twice a day and in addition a feed of hay.

"The proportion of treacle and linseed seems small, but it is sufficient to answer the purpose, causing the cattle to relish the food; singular to say, however, some of them refused to eat all up in the first week of feeding, but after that they cleaned up every bit, and there is not the slightest waste since.

"As to cost, this works out as follows:—

		£	s.	d.
Chop	4 cwt. at 4s.	1	12	0
Swedes	1½ cwt. at 2s.	0	3	0
Corn	1½ cwt.	0	12	0
Linseed	6 lb.	0	1	3
Treacle	12 lb.	0	1	0
		£2	9	3

"This is practically 1s. per beast per day (excluding hay).

"In thinking this matter over I came to the conclusion that two things would be required in forming a substitute for roots; the first was water, as you are well aware that there is a very large percentage of this in roots, and this is supplied by the addition of water. In the 25 buckets used, each cow would get half a bucket.

"The second thing required is something to keep the stomach in order and to prevent waste. This is amply done by the treacle and linseed, the feeding properties of which are greater than those of the roots.

"My idea of a first-class feed is one to keep the cattle in good health and growing steadily at reasonable cost, and I think that you will agree that in the above method, we are fulfilling this to advantage."

DESCRIPTION.	Price per Qr. s.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit. Starch Equiv. s.	Price per lb. Starch Equiv. d.
Wheat, British	48/–	504	10 13	1 0	9 13	71·6	2/8	1·43
Barley, English Feeding	36/–	400	10 2	0 18	9 4	71	2/7	1·38
„ Canadian „	32/–	400	8 19	0 18	8 1	71	2/3	1·20
Oats, English White „	34/3	336	11 8	0 19	10 9	59·5	3/6	1·87
„ „ Black & Grey	31/–	336	10 7	0 19	9 8	59·5	3/2	1·70
„ Canadian	32/6	320	11 7	0 19	10 8	59·5	3/6	1·87
„ Argentine	27/3	320	9 11	0 19	8 12	59·5	2/11	1·56
Maize, „	36/–	480	8 8	0 17	7 11	81	1/10	0·98
Beans, English Winter	51/6	532	10 17	1 15	9 2	67	2/9	1·48
Buckwheat	56/–	392	16 0	...	...	...	...	...
Rye, English	39/–	504	8 13	1 0	7 13	72	2/1	1·11
Millers' offals—Bran	—	—	9 10	1 16	7 14	45	3/5	1·83
„ „ Coarse middlings	—	—	9 10	1 7	8 3	64	2/9	1·38
Barley Meal	—	—	12 15	0 18	11 17	71	3/4	1·78
Maize „	—	—	8 10	0 17	7 13	81	1/11	1·03
„ Germ Meal	—	—	10 2	1 5	8 17	85·3	2/1	1·11
„ Gluten-feed	—	—	10 5	1 11	8 14	75·6	2/4	1·25
Bean Meal	—	—	14 0	1 15	12 5	67	3/8	1·96
Fish „	—	—	16 10	5 10	11 0	53	4/2	2·23
Linseed	—	—	17 5	1 16	15 9	119	2/7	1·38
„ Cake, English (9% oil)	—	—	14 10	2 6	12 4	74	3/4	1·78
Cottonseed „ English (5% oil)	—	—	9 10	2 6	7 4	42	3/5	1·83
„ „ Egyptian (5% oil)	—	—	9 5	2 6	6 19	42	3/4	1·78
„ „ decorticated (7% oil)	—	—	14 0*	3 11	10 9	71	2/11	1·56
Cocoanut Cake (7% oil)	—	—	11 0	1 19	9 1	74	2 5	1·30
Groundnut „ (7% oil)	—	—	11 0	3 5	7 15	73	2/1	1·11
Palm kernel cake (6% oil)	—	—	7 15*	1 9	6 6	75	1/8	0·89
Feeding Treacle	—	—	7 0	1 1	5 19	51	2/4	1·25
Brewers' grains, dried, ale	—	—	10 5	1 11	8 14	49	3/7	1·92
„ „ „ porter	—	—	9 5	1 11	7 14	49	3/2	1·70
„ „ wet, ale	—	—	2 11	0 8	2 3	15	2/10	1·52
„ „ wet, porter	—	—	2 6	0 8	1 18	15	2/6	1·34
Malt culms	—	—	7 10	2 3	5 7	43	2/6	1·34

FARM VALUES.	—	—	Value per Ton on Farm. £ s.	Manurial Value per Ton. £ s.	Food Value per Ton. £ s	S.E. per 100 lbs.	Value per s.	Market Value per lb. S.E. d.
Potatoes	—	—	0 18	0 5	1 13	18	1/10	0·98
Swedes	—	—	0 16	0 3	0 13	7	1/10	0·98
Mangolds	—	—	0 15	0 4	0 11	6	1/10	0·98
Good Meadow Hay	—	—	6 9	0 18	5 11	31	3/7	1·92
Good Oat Straw	—	—	3 11	0 10	3 1	17	3/7	1·92
Good Clover Hay	—	—	6 19	1 4	5 15	32	3/7	1·92
Vetch and Oat Silage	—	—	2 5	0 8	1 17	14	2/8	1·45

* Prices at Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of December and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £2 1s. per ton. The food value per ton is therefore £7 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 1d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·11d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

It will be noted from the above two extracts, that whereas the experience of one reader is in favour of the use of treacle, that of the other is against it. This apparent contradiction is due to the fact that treacle or molasses varies considerably in its laxative effect according to its origin and method of manufacture. Sugar cane molasses as a general rule is less likely to scour than beet sugar molasses. Owing to difficulty in handling, many farmers prefer to buy their molasses in the form of a molasses feed, and in such cases it is necessary to consider the character and nature of the substance used as an absorbent for the molasses. Many molasses feeds are on the market, and in buying these the farmer should ask himself two questions: (1) How much molasses is there present in one ton of the feed? (2) Is the absorbent material of feeding value? On the nature of the answer to these two questions, the value of the product largely depends.

Feeding Stuffs Table.—It will be noted that the allowance made for the manurial value of feeding stuffs is considerably less than in last month's table. The price of manures has dropped considerably, and the new values given in the table are based on the residual manurial value of the feeding stuff when the current unit values for nitrogen, potash and phosphoric acid are 14s. 5d., 4s. 9d. and 6s. 7d. respectively.

The table in question serves two purposes, *i.e.*, for comparison of purchased feeding stuffs, and for comparison of purchased feeding stuffs with home-grown produce.

In comparing the purchased feeding stuffs the price per lb. of starch equivalent should be used as the guide to comparative cheapness. Thus, coconut cake at 1.3d. per lb. of starch equivalent is much dearer than palm kernel cake at .89d. per lb. of starch equivalent. On the other hand, in comparing home-grown produce the values per ton form the basis of comparison. The price per ton given in the table for farm values indicates the actual value of produce on the farm with purchased feeding stuffs at their current prices.

As explained in a previous article this figure gives an indication whether or not it is best to sell home-grown feeding stuffs, and to buy in purchased feeding stuffs.

The following note has been communicated by Mr. H. Bradshaw, Beach Road, Cleveleys, Blackpool:—

Improvement of Grass Land in Lancashire.

In my capacity as Executive Officer I had exceptional opportunities of studying the grass land of the county. A large amount of this land is extremely well farmed, but it must be admitted that there is also a very large area which is badly farmed and not producing anything like the quantity of milk, beef and mutton that it is capable of producing. This latter class of land is to be found chiefly in the eastern part of the county on the coal measures and is a cold stiff clay. The herbage consists chiefly of bent, and through continued neglect the land is rapidly going back to moorland.

The basis of any improvement would appear to be lime. Nine-tenths of the farmers in East Lancashire, as the result of experience, say definitely that it is of no use applying manures to their land without first applying lime in some form.

Where a field is covered with a thick matting of bent it is no use applying a dressing of slag till this bent is got rid of, and nothing appears to get rid of it so well as a dressing of lime.* I have seen numbers of cases where slag has been applied to grass land and no results were visible. If, however, a dressing of lime was given, a marked difference in the character of the herbage was quickly seen, white clover taking the place of the bent. There is a pasture field situated within 6 miles of Manchester which, up to 1914, was let annually as a football field. Since 1914 football has not been played on it and no lime or manure applied. Whilst let as a football field the various touch lines were marked out with lime and these lines show to this day. Here the sward is quite green and full of clover whilst the remainder of the field is brown and benty.

My chief difficulty with farmers in these districts was in persuading them that lime was not a manure. A large number thought that if a field were limed every four years or so there was no necessity to apply any form of artificial manure. Others, however, are setting their neighbours an example of what can be accomplished by the use of lime and slag. Some landowners, too, are not behind in offering assistance to their tenants. In one case after I had inspected an estate of 5,000 acres and reported that lime was essential, the landlord made it known to his tenants that he was prepared to pay half the cost of liming.

* Mechanical treatment is recommended in the Ministry's Leaflet No. 275.

Needless to say a large number of the tenants took advantage of this offer.

A large number of small farmers in the vicinity of large towns, whose farms are wholly grass and who retail their milk, have let their land get into such poor condition that they now buy more milk than they produce. They are, in fact, little more than milk retailers. It is a common thing to find small farms carrying only one cow to every 4 acres. The pasture land is entirely neglected, never receiving manure of any kind other than the droppings of the cows in summer. The manure made in winter is applied to the meadows.

When these farmers are asked why they do not produce more milk they reply that their land is carrying as many stock as it can support and any increase in stock would necessitate buying feeding stuffs. They do not seem to grasp the fact that if they manured their pastures more grass of a better quality would be obtained, which would enable them to increase their stock and consequently produce more milk without the aid of feeding stuffs.

* * * * * *

Potato Maturity Trials, 1921.

POTATO maturity trials were carried out in 1921 by the National Institute of Agricultural Botany at its Ormskirk Station. The object was to test a suggested method for (*1*) demonstrating the relative times of ripening of potato varieties, (*2*) establishing the relative yielding capacities of different varieties, and (*3*) determining the influence of place of origin of seed in respect to both maturity and cropping.

Equal weights of stocks of immune varieties comprising seven of the best known second earlies and two varieties on the borderlines of this group were obtained from several districts in England and Scotland. A single plot of each stock of all the varieties was planted, the whole forming a chequer-board which was so arranged that different varieties, and stocks from different districts were scattered over the area used for trial. At the end of the growing period the date on which each plot became mature was determined, and the produce of every plot was lifted and weighed as it matured.

Conclusive results could not be expected from a single year's trial, but the data indicate that the method adopted is sound, and that, when slight modifications have been made, reliable results of great practical and scientific value will be secured. Although the figures obtained so far must be regarded as

suggestive only, and the experiments require a further extension before any general conclusions can be drawn, it is advisable that they should be placed on record. They are, therefore, summarised below. The order of merit of the varieties for early maturity and for high yield are given in brackets.

Variety.	*Average time to mature (in days from planting).*	*Average yield (calculated in tons per acre).*			
		Ware.	*Chats.*	*Total.*	
Dargill Early ...	(1) 77 ...	5·1 ...	·8 ...	5·9	(9)
Nithsdale... ...	(2) 94 ...	6·6 ...	1·8 ...	8·4	(8)
Arran Comrade ...	(3) 99 ...	7·0 ...	1·7 ...	8·7	(7)
The Ally ...	(4) 119 ...	10·0 ..	·5 ...	10·5	(5)
King George ...	(5) 121 ...	11·5 ...	·5 ...	12·0	(2)
Great Scot ...	(6) 124 ...	9·7 ...	·6 ...	10·3	(6)
K. of K.	(7) 130 ...	10·9 ...	·7 ...	11·6	(3)
Tinwald Perfection	(8) 134 ...	11·5 ...	·8 ...	12·3	(1)
Early Market ...	(9) 135 ...	9·3 ...	1·5 ...	10·8	(4)

Though primarily arranged as a test of method, the figures would appear to justify the inference that when varieties are compared with each other a negative correlation between high yield and early maturity may be anticipated. The full data (which are not here reproduced) also suggest in respect to maturity that within a variety neither the place of origin nor the small irregularities in the soil of the trial ground have any material effect, but that both have a very considerable influence on yield.

These indications will be further tested this year. The same varieties will be used, but the system will be somewhat modified in the light of last season's experience.

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World's Poultry Congress.

The transactions of the First World's Poultry Congress held at the Hague, Holland, from 5th to 9th September, 1921, were recently published in two volumes.

Volume I.—"Papers and Communications," is divided into four sections, which are as follows :—

(*a*) Experiments, investigations, science of breeding and its practical applications.

(*b*) State and other official action, including reconstruction.

(*c*) Hygiene and disease.

(*d*) The training and necessary qualifications of poultry instructors. Educating and demonstrating work.

Volume II.—Proceedings of the Congress.

These volumes contain reports on practical poultry work, poultry education, and investigations and research into diseases

of poultry, which are being carried on in Europe and other countries, together with a report of the actual proceedings of the Congress, which was attended by the largest gathering of persons interested in poultry keeping that has ever been known.

The reports are in the form of papers which were read at the Congress by the delegates from governments, research stations, universities and colleges, members of the more important societies, and well known commercial poultry breeders.

This unique collection of varied and up-to-date useful information on all matters referring to poultry should prove of inestimable value to all engaged in the development of the poultry industry in this country. Universities, colleges, farm institutes and other educational centres should endeavour to obtain these volumes for use in their libraries. Private and commercial poultry keepers should also obtain them as they contain the latest information on the various phases of the poultry industry.

Copies may be obtained from C. S. Th. Van Gink, Office of Secretary General, 30, Bezuidenhoutschewez, The Hague, Holland. The price of the two volumes is £1, plus 2s. 6d. postage. International post money orders must be used.

A supply of Volume I has been received by Mr. T. R. Robinson, 3, Vincent Square, Westminster, London, S.W.1, who will supply copies on receipt of 10s. 6d. plus 1s. for postage. Volume II will be available shortly.

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Spraying Potatoes for "Blight" in Berkshire.

An experiment which has been concluded after nine seasons' trials at the University College Farm, Reading, has yielded some interesting results with regard to the spraying of the potato crop with the ordinary field-horse sprayers. The College farm at Shinfield, where the trials have been carried out, is 200 ft. above sea level, and there is a general opinion that the rainfall is higher in the Thames Valley below. The economic value of spraying probably therefore holds over quite a considerable area, even in this comparatively dry part of the country.

During the course of the experiment four plots, of $\frac{1}{8}$ acre each, were measured every year and treated as follows:—

(*a*) Not sprayed; (*b*) Sprayed once, early; (*c*) Sprayed once, late; (*d*) Sprayed twice, early and late.

The early spraying was given about the beginning of July, about a fortnight after potatoes were earthed up, and the late

spraying was given about a fortnight to three weeks later according to the suitability of the weather.

The crop was grown under the ordinary field conditions in ridges 30 in. apart and 14 in. between the sets. The manuring each year was constant, while a modified Bordeaux mixture was the spray adopted in each case, the ingredients used being 14 lb. of copper sulphate and 9½ lb. of lime to 100 gallons of water. Approximately 100 to 120 gallons of mixture were applied per acre at each spraying.

The following figures show the average yields per acre recorded throughout the trials, together with the average percentage of diseased tubers (by weight), and the average percentage of sound seed (by weight) of the total crop :—

	Not sprayed.	*Sprayed once, early.*	*Sprayed once, late.*	*Sprayed twice early and late.*
	tons. cwt.	tons. cwt.	tons. cwt.	tons. cwt.
Average yields per acre for 9 years, 1911–20	7 5¾	8 4	8 4	8 10½
	percentage.	*percentage.*	*percentage.*	*percentage.*
Average percentage of diseased tubers for the period ...	5·49	5·44	4·03	4·09
Average percentage of seed tubers for the period... ...	19·78	19·57	18·79	18·43

The conclusions to be drawn from this experiment show that not only has spraying increased the total crop on the average, but it has also increased the percentage of sound saleable ware tubers.

The percentage of seed by weight shows a small reduction in the case of the sprayed plots, while on the chats spraying caused a definite reduction in percentage occurrence.

Spraying also reduced the percentage occurrence on the average of diseased tubers on all the plots and particularly in the late sprayed and double sprayed plots.

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The Hop Control.

THE Hop Control, which consists of a Board or Committee composed of representatives of hop growers, merchants, factors and brewers, acting under the chairmanship of the Hop Controller, was established by a minute of appointment of the President of the Board of Agriculture, dated 6th October, 1917, in order to secure the restoration of the English acreage under hops which had been reduced by earlier orders during the War. The

chairman of the board was not then called the Hop Controller, but was appointed as such by order of the Food Controller, dated 9th January, 1919, made after consultation with the Board of Agriculture and Fisheries. The powers given to the Food Controller in that order include the following :—

"(*a*) To take control of the hop industry ; (*b*) to take over all such stocks of hops as may be from time to time determined ; (*c*) to buy and sell hops ; (*d*) to grant permits exempting any persons from all or any of the provisions of the Hops (Restriction) Order, 1917, as amended by the Hops (Restriction) Order, No. 2, 1917, subject to such conditions, restrictions, and upon such terms as the controller may think fit ; (*e*) to enforce the due observance and performance of the said orders, and all such further orders respecting hops and for controlling the hop industry which the Food Controller may from time to time issue ; (*f*) to issue such rules and regulations respecting hops, and for controlling the hop industry as he may from time to time determine ; (*g*) to enforce the due observance and performance of the rules and regulations issued by him, and such further rules and regulations as he is by this authority authorised to issue."

A further order of 14th May, 1920, called the Hops (Restriction on Delivery) Order, 1920, made by the Food Controller, prohibited any person from taking delivery of any hops arriving in the United Kingdom after 10th June, 1920, except under licence of the Food Controller. In the earlier years of control, importation had been entirely prohibited.

It should be borne in mind that this control was set up at the urgent request of the hop growers and merchants, many of whom feared the extinction of the industry.

The powers thus conferred were subsequently dealt with in section 4 of the Ministry of Food (Continuance) Act, 1920, which ran as follows :—

"4.—(1) With a view to assisting the industry of hop growing in the United Kingdom to recover from the injury which it suffered during the War, the Food Controller during the continuance of his office shall have, and exercise, any powers in relation to hops which at the time of the passing of this Act were exercisable by him, and may by order prohibit or regulate the importation of foreign hops in such manner as may appear to him necessary. . . . .

(2) An order under this Act providing for the transfer of the powers of the Food Controller under this section to any other government department or departments may, notwithstanding anything in this Act, provide for the continuance of the power so transferred until the expiration of a period of five years from the passing of this Act, and in such case the provisions of this Act, so far as necessary, shall continue to have effect accordingly."

The final power was the order in council of 24th March, 1921, made by His Majesty in accordance with the section quoted above transferring the powers of the Food Controller under that

section to the Minister of Agriculture and Fisheries, under whom the hop control is therefore continued. The order in council provided for the continuance of the powers until 16th August, 1925, *i.e.*, until the expiration of the period of five years from the date of the passing of the Act.

It should be mentioned that in the first period of its existence the hop control was given a state guarantee against loss, which enabled banks to finance its operations at a favourable rate of interest, but later that was discontinued. No charge, however, has at any time fallen upon the State, since the sale of the hops brought into the control has always covered the costs of the operations. The control buys all hops produced in this country and sells them to brewers. Its price is fixed in advance for each crop and is based upon the average cost of production after allowing a reasonable profit to the grower. The prices per cwt. have been as follows :—for the 1917 crop, £7 15s.; 1918 crop, £16 10s.; 1919 crop, £18 5s.; 1920 crop, £17 10s.; and the 1921 crop, £18.

The pre-war acreage of hops was about 36,000 acres, which was reduced during the War to about 15,000 acres. The acreage in 1921 was over 25,000 acres. In the three previous years it was about 15,600, 16,700 and 21,000 acres respectively, so that it is clear that the policy of hop control is effecting the object for which it was instituted.

A special point as to importation of hops is worthy of notice. It is an essential part of the policy of the hop control to release foreign hops only after the English crop has been taken up at the controlled price. Therefore, though brewers may, at their own risk, contract for the purchase of foreign hops, they can only obtain authority for their delivery up to an amount to cover existing requirements—but not to build up stocks to the prejudice of future crops—after the English crop is disposed of, and they have bought up their fair share of it.

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New Onion Smut Order.

In May, 1920, an Order for the control of the disease known as "Onion Smut" was issued by the Ministry. This Order enabled the Ministry to take immediate action should the disease be found in other parts of this country. No further outbreaks of the disease have been reported, however, and recent research has revealed adequate measures for its treatment. A new Order has therefore been issued containing less stringent

but equally effective regulations. The new Order provides that the sowing of onion or leek seeds or the planting of seedlings in land known to be infected may be carried out only under licence from the Ministry; such licences will be granted only after certain prescribed measures of treatment have been adopted. The distribution of onion or leek plants from infected land is also subject to control.

Copies of the Order in question, "The Onion Smut Order of 1921" (S.R. & O., 1921, No. 1620), may be obtained through any bookseller, or direct from H.M. Stationery Office, Imperial House, Kingsway, W.C.2, price per copy 1d. net.

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Licensing Stallions under the Horse Breeding Act, 1918.

STALLION owners in England and Wales who intend to travel their stallions during the 1922 season are reminded again that they will require licences from the Ministry to enable them to do so, and that as the Ministry cannot undertake to issue licences at very short notice, owners of stallions who postpone the necessary application may experience considerable delay in obtaining them.

With the approach of the Spring sales and shows, it should also be noted that a licensee is required to give notice forthwith to the Ministry of any sale, or letting for a period exceeding six months, or other change of the ownership of a licensed stallion. The licence should be given to the purchaser or lessee who should apply immediately to the Ministry for a new one, as the existing licence ceases to be in force at the expiration of one month after the change of ownership. A new licence will be issued free of charge. Any contravention of the Act in this respect renders the offender liable to a fine not exceeding £5.

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Director of Kew Gardens.

LIEUT.-COL. SIR DAVID PRAIN, C.M.G., C.I.E., F.R.S., will shortly retire from the post of Director of The Royal Botanic Gardens, Kew, which he has held since 1905, and the First Lord of the Treasury has appointed as his successor, Mr. A. W. Hill, Sc.D., M.A., F.L.S., who has been Assistant Director of the Gardens for the last fourteen years, and was previously Fellow and Dean of King's College, Cambridge, and University Lecturer in Botany.

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Erratum.—With reference to the article on "Insecticides and Fungicides" which appeared in the October, 1921, issue of this *Journal*, it is regretted that the percentage of hydrocyanic acid which sodium and potassium cyanides are respectively capable of evolving was incorrectly stated on p. 631. In the case of sodium cyanide the percentage of hydrocyanic acid should read 54 instead of 56, and in the case of potassium cyanide 39·4 instead of 43·7.

Foot-and-Mouth Disease.—No further outbreak of foot-and-mouth disease has been confirmed in any part of Great Britain since that near Sevenoaks, Kent, on 24th November last, referred to in the January issue of the *Journal*. The measures adopted by the Ministry were successful in preventing any extension of that outbreak, and the restrictions were withdrawn as from 19th December, 1921.

Leaflets issued by the Ministry.—Since the date of the list given on p. 954 of the January *Journal*, the following three new leaflets, of which those marked with an asterisk will, provisionally, be supplied free, have been issued:—

No. 380.—The Making of Fruit Pulp (Formerly F.P. 41).
„ 381.—How to Keep Swine Fever away.*
„ 383.—Hints on Goat Keeping.*

The following have been revised or amended:—

No. 44.—The Lapwing, Green Plover or Peewit.
„ 134.—Profitable Apples for Market.
„ 166.—Some Common Thistles.
„ 195.—American Gooseberry Mildew.
„ 210.—The Oyster-Shell Scale.
„ 302.—Silver Leaf in Fruit Trees.
„ 306.—The Goat as a Source of Milk.
„ 328.—Smut in Oats and Barley.
„ 334.—Potash Fertilisers.
A316/I.—Abridged list of Publications.*

The following Leaflet has been rewritten:—

No. 297.—Seed Testing.*

The following Leaflet has been temporarily withdrawn:—

No. 300.—The Breeding of useful Pigeons.

Distribution of Leaflets.—Persons who require information on a definite point dealt with in one of the leaflets, can obtain the leaflet in question free of charge, but if several leaflets are required, a charge will be made at the rate of 1d. each or 9d. per dozen, post free.

NOTICES OF BOOKS.

The Wheat Plant.—(John Percival, M.A., F.L.S., Professor of Agricultural Botany at University College, Reading: pp. 463: 63s. net: Duckworth & Co.). The agriculturist—student, farmer, scientist—has again and again been heard to ask "What is the best book about Wheat?" He has been referred to Körnicke in the German or Vilmorin in the French, but in English, with a few inconspicuous exceptions, there has been no book to recommend. This should not be regarded as an indication of ignorance on the part of English-speaking agricultural botanists nor of inertia, but it is due simply to the difficulty of collecting a vast mass of fact from an almost limitless field. The field is wide because the growing of wheat is a staple of English farming, its preparation for food involves big industries, and the scientific problems it presents have attracted research-workers from every department of botany and chemistry. He who would write a book about wheat, then, must cast his net wide and have it very fine or he will surely miss something that one or another of a host of expectant readers would have him deal with. Whatever may be felt about this book it will at any rate be granted that Professor Percival has essayed to add something entirely new to English agricultural literature.

The book is in two sections, and throughout it is adorned—there is no other word—with the beautiful drawings and photographs that are to be expected from its author.

Part I describes the anatomy, the structure of all the parts, of the wheat plant. Every detail of leaf, stem, flower and grain is accurately portrayed, from the sprouting of the seed in the soil to the time when the plant is ripe and ready to harvest. The root-system, the part upon which so much depends but to which farmer and botanist alike are apt to pay so little attention, is fully treated. Further, what is rare in books upon cereals, there is an explanation of the part which the roots play in "lodging." "quality" or "strength" of grain finds a place, but, as many will feel, an inadequate one. The miller has strong views upon the "kind" of wheat he desires—what English farmer does not know that his wheat makes less per quarter than the "strong" wheats of America, and elsewhere?—and the chemist has sought to describe in his own language the kind of wheat that will make the large, well-risen loaf. These things the author barely mentions, and perhaps the reason is disclosed by a passage in the second part: "So-called 'strength' of grain is important, but wheats of the highest quality in this respect invariably give small yields, and the consumer or his agents rarely pay enough for the superior quality to cover the loss due to diminished yield. It usually pays the producer to grow wheat of inferior milling quality, and this has been specifically recognised and adopted as a sound policy by the most successful wheat growers during the last two hundred years in this country." Time alone can be the critic of this pronouncement, but science would be wanting if it accepted fatalistically the dogma that high yield cannot be combined with a quality at any rate considerably superior to that of most of the wheats grown in England during the last two hundred years. Not a few, indeed, are convinced that this has already been abundantly disproved.

Part II consists in the main of the systematic classification, the cataloguing, of all the kinds of wheat upon which the author could lay hand. They came to him from every part of Europe, from India, from Persia, from America, from Japan, from Australia, from nearly every quarter in which wheat grows, and are marshalled into groups and sub-groups according to their varying characteristics. Botanists who do this kind of work are a quarrelsome set and the three new "races" (sub-groups) that the author has added to his catalogue of wheats will stir up contention. Some of the world's wheat tracts, Mesopotamia for example, are still imperfectly known to botanists, and their exploration may make yet another re-sorting of the catalogue necessary, but those whose interest is non-critical and lies in the strange multiplicity of the world's wheats may here regale themselves with descriptions and excellent photographs.

Into the last hundred pages is compressed the matter that, for practical purposes, is the most important of all. There is a chapter on "variation" wherein "sport" forms of wheat are described and a brief explanation is given of the use of "statistical methods," the checks which serve to show whether the numbers and measurements obtained in experiments are or are not likely to be misleading. The professional statistician may here raise his complaining voice, for the author has, all through, omitted to test, in this way, the numbers and measurements which he has so abundantly furnished.

Nowadays most of our wheats are "hybrids," and Professor Percival gives a survey of the laws of inheritance which have been disclosed by the breeding of hybrids and an account of some strange "mongrels" out of wheat crossed on to barley or on to rye. Pessimism runs through the chapter on "Improvement and Breeding of Wheat." Mendel's discovery receives its tribute but we read, "most of the characters whose inheritance has been clearly established are of no economic importance" . . . "the grain-yielding capacity of the plant . . . either does not Mendelise or is at present beyond Mendelian analysis . . . " In so saying, the author displays the caution which an exceedingly difficult problem necessitates, but the omission of what has been done in this important direction is regrettable.

Very appropriately, a chapter on "Yield" concludes the text. Yields in the different countries of the world, yields in ancient times, the influences of manuring, cultivation, large and small seed, high and low seed rate—all these are briefly reviewed. Perhaps wisely, the author scarcely hints at an attempt to analyse "yielding power"—to specify the features of the different wheat varieties that make them heavy or poor yielders. He might usefully have trod firmer ground, however, by describing how to "test" yielding-power accurately. A bumper crop one year on an experimental plot or even on a field is not sufficient to stamp a "variety" as an exceptionally high yielder, and accurate methods of testing yielding-power are to-day almost pre-eminently important in crop-work.

The diseases of the wheat plant and their treatment constitute a great subject on which admirable and successful work has been done. An account of this would have enhanced the value of the monograph, but perhaps it ought to be considered beyond its scope. Technical readers may, indeed, be constrained to feel that not one but a series of monographs from more than one pen is necessary to present all that is known about the wheat plant.

A book about wheat must have a horde of critics: but the general agricultural reader will find collected here what he must seek in vain in any other single volume in English.

Practical Gardening for Pleasure and Profit.—(The Educational Book Company Ltd., 17 New Bridge Street, London, E.C. Price £4 5s. art vellum, or £5 14s. art canvas, net, for six volumes.) The first volume of this work deals with gardening practice; with gardens suitable for houses in various situations in country, town and suburb; with school gardens, etc. The second treats almost exclusively of vegetable crops, but includes much useful information concerning allotments. In the third volume fruit growing, as it should be practised in small gardens, is dealt with in a way which will commend itself to most growers of fruit for domestic purposes. In the fourth volume the subject of gardening under glass is considered at length, and a useful encyclopædia of indoor plants has been included. The fifth and sixth volumes deal with the growing of flowers, a subject which interests almost every section of the community.

In the past few years an immense development has taken place in practical gardening and horticulture generally, and there was a need for a comprehensive work of this nature, and "Practical Gardening" will be much appreciated.

This work, which has been edited by Mr. Walter P. Wright, the well-known writer on gardening subjects, who for a long time has been the Horticultural Superintendent in Kent, has been presented in a simple and interesting style. Mr. Wright has been fortunate in securing other well-known horticulturists to contribute to sections of the work in which they possessed expert knowledge. The scientific and practical value of the work has been increased by the addition of articles from authorities such as Sir Harry Veitch, Messrs. Edwin Beckett, M. C. Allwood, W. Cuthbertson, Joseph Cheal, and R. W. Wallace, all well-known practical horticultural men; together with contributions on scientific subjects from such reliable writers as Dr. E. J. Russell, Mr. F. J. Chittenden, and others.

The presentation of the book is exceedingly good, and it is abundantly illustrated with most excellent drawings and photographs, some of which are coloured. The inclusion of these makes it more easily understood, and adds to the attractiveness of the whole work, which is a valuable addition to horticultural literature. H.V.T.

The Swedish Agricultural Labourer.—(Published by order of the Swedish Government's delegation for International Collaboration in Social Politics, Stockholm, 1921.) The prospect of an international discussion on the economic conditions of agricultural labour in Europe led the Swedish Government to issue this monograph, which gives much interesting and valuable information regarding a subject that is little known to English students. Of the eleven short chapters only one, the first, is devoted to general agriculture, and even this is prepared with the object of elucidating the origin and causes of the conditions which are subsequently described. The remaining chapters deal with such questions as the number and distribution of agricultural labourers in Sweden, their wages, hours of work, housing and right of combination, the labour of women and children, insurance against old age, sickness and accident, technical instruction and land settlement. English readers will perhaps be most impressed by the primitive and almost

patriarchal conditions that still prevail in many parts, reminiscent in many respects of mediæval England, and the feudal system. We learn on p. 25 that there are no fewer than 59,650 male and 4,135 female small holders, known as *torpare*, who correspond with the mediæval villein. In certain districts the crofts are owned by the occupiers, but in the eighteen more southerly counties of Sweden, 33 per cent. are let to persons who undertake as part of the duties of their tenure to carry out a certain number of days' work on the landlord's farm. The system, however, is disappearing, as might be supposed, in favour of a money rent. Again, there are a body of farm servants, known as *statare*, who, instead of being fed in the house of their employer receive a food allowance which they consume at home. Many of these, however, have commuted these allowances for an allotment of land and fodder for their cow. As is pointed out in the pamphlet, the number of kinds of agricultural labour is great, and while one type will prevail in one district it can hardly be found in another. The variations are due chiefly to the size of the holdings, and the conditions, principally climatic, under which the industry is carried on. The whole book deserves careful study by all who are interested in the conditions of agricultural labour in foreign countries.

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ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

Russell, E. J.—Soil Conditions and Plant Growth. (4th Edition.) [The Rothamsted Monographs on Agricultural Sciences.] (406 pp.) London: Longmans, Green & Co., 1921, 16s. [63.115; 63.161.]

Haas, P. and *Hill, T. G.*—An Introduction to the Chemistry of Plant Products. Vol. I. On the Nature and Significance of the Commoner Organic Compounds of Plants. (3rd Edition.) (414 pp.) London: Longmans, Green & Co., 1921, 16s. [58.11; 54(02).]

Bosanquet, R. C.—The Beginnings of Botany: Some Notes on the Greek and Roman Herbalists. (20 pp.) Edinburgh: Neill & Co., Ltd., 1919. [58(04).]

Everall, Wm.—Farmers' Account Book. (4th Edition, revised.) (50 pp.) Published by the Author, Exchange Offices, Shrewsbury, 1921, 10s. 6d. [657.]

Game and Heather-Burning (Scotland) Committee.—Report of the Committee with the Minority Report. (35 pp.) London: H.M. Stationery Office [Cmd. 1401.] 1921, 6d. net. [343.771; 63.26; 63.142.]

Royal Commission on the Importation of Store Cattle.—Report of the Commissioners. (15 pp.) [Cmd. 1139.], 2d. net.

Proceedings before the Commission, Minutes of Evidence and Appendices. (605+LXXIV pp.) [Cmd. 1541.], 35s. net. London: H.M. Stationery Office, 1921. [63.6 : 38; 382.]

Salter, M. de Carle S.—The Rainfall of the British Isles. (295 pp.) London: University Press, 1921, 8s. 6d. [551.5.]

Department of Scientific & Industrial Research.—Statistical Supplement to the Final Report of the Nitrogen Products Committee of the Ministry of Munitions. (22 pp.) London: H.M. Stationery Office, 1920, 1s. net. [63.1671; 668.6.]

Merchandise Marks Committee.—Report to the Board of Trade. (16 pp.) London: H.M. Stationery Office [Cmd. 760.], 1920, 2d. net. [343.53(b).]

Plant Diseases.

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